DOCUMENT RESUME

ED 131 295 CE 008 919

AUTHOR	Curtis, Ed
TITLE	Forestry. A Curriculum Guide.
INSTITUTION	Oklahoma State Dept. of Vocational and Technical Education, Stillwater. Curriculum and Instructional Materials Center.
REPORT NO	VT-103-251
PUB DATE	74
NOTE	455p.; Pages 9-B and 10-B (containing a key to the genera of Oklahoma trees), and 62-B (containing a conversion factor table), will not reproduce well due to small, faint type
EDRS PRICE	MF-$0.83 HC-$24.77 Plus Postage.
DESCRIPTORS	Behavioral Objectives; Curriculum Guides; *Forestry; Forestry Aides; *Learning Activities; Resource Materials; Senior High Schools; Tests; Transparencies; Unit Plan; *Vocational Agriculture

ABSTRACT

The curriculum guide was developed to prepare high school students for positions as forestry aides or for enrollment in higher education forestry programs. It provides a basic core of instruction in forestry in 20 instructional units grouped according to six areas: Orientation, Related Information, Forest Measurements, Forest Ecology and Siviculture, Forest Protection, and Forest Management. Each instructional unit includes behavioral objectives, suggested activities for teacher and student, information sheets, transparency masters, assignment sheets, job sheets, a test, and test answers. (Author)

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ED131295

FORESTRY

A CURRICULUM GUIDE

Written by

ED CURTIS
CONSULTANT FORESTER
1974

U.S. DEPARTMENT OF HEALTH,
EDUCATION & WELFARE
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For the Division of Vocational Agriculture
Byrle Killian, State Supervisor
OKLAHOMA STATE BOARD OF VOCATIONAL AND TECHNICAL EDUCATION
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State Department of Vocational and Technical Education
Stillwater, Oklahoma 74074

FORESTRY
TABLE OF CONTENTS

Section A Orientation

Unit I The Forest

Section B Related Information

Unit I Identifying Oklahoma Trees
Unit II Using Measurement Units to Solve Forestry Problems

Section C Forest Measurements

Unit I Forest Surveying
Unit II Forest Land Location
Unit III Tree Measurements
Unit IV Log Scaling
Unit V Pine Tree Grading
Unit VI Hardwood Tree Grading
Unit VII Strip Cruising
Unit VIII Plot Cruising
Unit IX Point Sampling

Section D Forest Ecology and Siviculture

Unit I The Sivicultural System
Unit II Marking Timber in Thinnings
Unit III Seeding and Planting
Unit IV Timber Stand Improvement

Section E Forest Protection

Unit I Fire Fighting
Unit II Prescribed Burning
Unit III Insect Damage Identification

Section F Forest Management

Unit I Forest Business Methods

FOREWORD

This publication is designed to provide a basic core of instruction in Forestry for Oklahoma. Today, teachers of vocational agriculture are faced with increasing problems of what to teach and whom to serve. The student of today, who will be the agriculturalist of tomorrow, needs to be a well-educated individual who is constantly seeking information on which to base the many decisions he is required to make. The purpose of this guide is to assist teachers in improving instruction in Forestry in Oklahoma.

Appreciation is expressed to the many individuals who helped in the development of this publication; the teaching of vocational agriculture should become more effective with its use.

Francis T. Tuttle, State Director
State Department of Vocational
and Technical Education

Byrle Killian, State Supervisor
Vocational Agriculture

PREFACE

With a rapid increase in technology and technical procedures, the forestry industry is currently hard pressed to fill technical and skilled jobs with qualified people. They recognize the advantage of having school trained personnel that can "hit the ground running."

Every effort has been made to make this publication a basic, usable forestry curriculum to produce a forestry aide capable of filling industries' needs.

The curriculum is designed to be presented in numerical order. Each unit serves as a building block for the units following. However, each unit can be presented out of order, but this will require additional background instruction.

One vital part of instruction--SAFETY--is not included in this publication. Because of the varied laboratory conditions and the numerous types of equipment used, safety procedures would add as much instructional material as is presented in this publication. This author advises that safety not be left out of instruction. Each instructor should supplement this publication with safety materials.

After completion of these twenty units of instruction in a high school program, each instructor should be able to proudly send his students to responsible jobs in the forest industry or to a higher education forestry program.

Ed Curtis
Consultant Forester

ACKNOWLEDGEMENTS

Appreciation is expressed to many individuals who gave their time and knowledge to the preparation of this publication. Without the combined efforts of teachers of vocational agriculture and the supervisory staff of vocational agriculture, State Department of Vocational and Technical Education, this publication would not have been possible.

The content of this publication was prepared and reviewed by:

Instructors of Vocational Agriculture

Charles Hathaway	Tahlequah
Colbert Starr	Stillwell
Robert Wood	Sallisaw
Lee Zuck	LeFlore
Jack Brock	Broken Bow
Haskell Pate	Haworth

Appreciation is expressed to Dean Reeder and Clifton Braker, Curriculum Specialists, who supervised the writing and committee meeting.

Appreciation is also extended to the Forestry Department, Oklahoma State University, for their assistance and cooperation in the final stages of this publication.

Gratitude is expressed to Beth Parker and Sarah Mussett for editing; to Nancy Skach and Barbara Reed for assistance with research; and to Linda Tapp, Cindy Johnson, and the Communications Center for typing.

Much credit goes to Bob Rea, Media/Graphics Designer, and to Susan Bell, Dean Clark, and Beth Akins, Illustrators, for the illustrations and drawings used in this publication.

The printing staff of the State Department of Vocational and Technical Education are deserving of much credit for printing this publication.

Special appreciation is extended to my wife, Mary Curtis, for her encouragement and assistance in typing while preparing the publication.

Also special appreciation is extended to Bob Patton, Assistant Coordinator for the Oklahoma Curriculum and Instructional Materials Center, and Cleo Collins, Southeast District Supervisor for Vocational Agriculture, for their counseling and assistance.

Ed Curtis
Consultant Forester

USE OF THIS PUBLICATION

Instructional Units

The Forestry curriculum includes six areas. Each area consists of one or more units of instruction. Each instructional unit includes behavioral objectives, suggested activities for teacher and student, information sheets, assignment sheets, job sheets, visual aids, a test, and answers to the test. Units are planned for more than one lesson or class period of instruction.

Careful study of each instructional unit by the teacher will help him determine:

A. The amount of material that can be covered in each class period.
B. The skills which must be demonstrated.
    1. Supplies needed
    2. Equipment needed
    3. Amount of practice needed
    4. Amount of class time needed for demonstrations
C. Supplementary materials such as pamphlets and filmstrips that must be ordered.
D. Resource people that must be contacted.

Objectives (White)

Each unit of instruction is based on behavioral or measurable objectives. These objectives state the goals of the course in such a way that both teacher and student will know the changes in behavior expected to occur as a result of the instruction. In short, objectives are a means of providing a sense of direction and accomplishment for the student.

Behavioral objectives are stated in two forms: terminal objectives stating the subject matter to be covered in a unit of instruction and specific objectives stating the student performance necessary to reach the terminal objective. Specific objectives are most important in regard to teaching the unit. Before attempting to teach a unit, terminal and specific objectives must be explained to the student in order for him to know what is expected of him.

Since the objectives of the unit provide direction for the teaching-learning process, it is important for the teacher and students to have a common understanding of the intent of the objectives. A limited number of performance terms have been used in the objectives for this curriculum to assist in promoting the effectiveness of the communication among all individuals using the materials.

Following is a list of performance terms and their synonyms which were used in this material:

Name	Identify	Describe
Label	Select	Define
List in writing	Mark	Discuss in writing
List orally	Point out	Discuss orally
Letter	Pick out	Interpret
Record	Choose	Tell how
Repeat	Locate	Tell what
Give		Explain

Order
Arrange
Sequence
List in order
Classify
Divide
Isolate
Sort

Distinguish
Discriminate

Construct
Draw
Make
Build
Design
Formulate
Reproduce
Transcribe
Reduce
Increase
Figure

Demonstrate
Show your work
Show procedure
Perform an experiment
Perform the steps
Operate
Remove
Replace
Turn off/on
(Dis) assemble
(Dis) connect

Reading of the objectives by the student should be followed by a class discussion to answer any questions concerning performance requirements for each instructional unit.

Teachers should feel free to add objectives which will fit the material to the needs of their students and community. When a teacher adds objectives, he should remember to supply the needed information, assignment and/or job sheets, and criterion tests.

Suggested Activities (White)

Each unit of instruction has a suggested activities sheet outlining steps to follow in accomplishing specific objectives. The activities are listed according to whether they are the responsibility of the instructor or the student.

Instructor: Duties of the instructor will vary according to the particular unit; however, for best use of the material they should include the following: provide students with objective sheet, information sheets, assignment sheets, and job sheets; preview filmstrips, make transparencies, and arrange for resource materials and people; discuss terminal and specific objectives and information sheets; give test. Teachers are encouraged to use any additional instructional activities and teaching methods to aid students in accomplishing the objectives.

Students: Student activities are listed which will help the student to achieve the objectives for the unit.

Information Sheets (Green)

Information sheets provide content essential for meeting the cognitive (knowledge) objectives of the unit. The teacher will find that information sheets serve as an excellent guide for presenting the background knowledge necessary to develop the skills specified in the terminal objective.

Students should read the information sheets before the information is discussed in class. Students may take additional notes on the information sheets.

Transparency Masters (White)

Transparency masters provide information in a special way. The students may see as well as hear the material being presented, thus reinforcing the learning process. Transparencies may present new information or they may reinforce information presented in the information sheets. They are particularly effective for such activities as learning and locating the parts of a machine.

Transparencies should be made and placed in the notebook where they will be immediately available for use. Transparencies direct the class's attention to the topic of discussion. They should be left on the screen only when topics shown are under discussion. (NOTE: Stand away from the overhead projector when discussing transparency material. The noise of the projector may cause the teacher to speak too loudly.)

Assignment Sheets (Tan)

Assignment sheets give direction to study and furnish practice for paper and pencil activities to develop the knowledge which is a necessary prerequisite to skill development. These may be given to the student for completion in class or they may be used for homework assignments. Answer sheets are provided which may be used by the student and/or teacher for checking student progress.

Job Sheets (Blue)

Job sheets are an important segment of each unit. The instructor should be able to and in most situations should demonstrate the skills outlined in the job sheets. Procedures outlined in the job sheets give direction to the skill being taught and allow both student and teacher to check student progress toward the accomplishment of the skill. Job sheets provide a ready outline for a student to follow if he has missed a demonstration. Job sheets also furnish potential employers with a picture of the skills being taught and the performances he might reasonably expect from a person who has had this training.

Test and Evaluation (Yellow)

Paper-pencil and performance tests have been constructed to measure student achievement of each objective listed in the unit of instruction. Individual test items may be pulled out and used as a short test to determine student achievement of a particular objective. This kind of testing may be used as a daily quiz and will help the teacher spot difficulties being encountered by students in their efforts to accomplish the terminal objective. Test items for objectives added by the teacher should be constructed and added to the test. Progress sheets are provided for student and teacher to record acceptable performance of skills outlined in job sheets.

Test Answers (Pink)

Test answers are provided for each unit. These may be used by the teacher and/or student for checking student achievement of the objectives.

THE FORESTS
UNIT I

TERMINAL OBJECTIVE

After completion of this unit, the student should be able to describe how a tree grows and list the important parts of a tree. He should be able to list the classifications of stands of trees and identify trees based on tree classifications of size and tree crowns. This knowledge will be evidenced through demonstration and by scoring eighty-five percent on the unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms associated with tree growth and forests.
2. List the three main parts of a tree.
3. List the four parts of tree crowns.
4. Label the five parts of a tree trunk when given a drawing of an exposed tree trunk.
5. Label the three parts of the tree roots when given a drawing.
6. Describe the general process for photosynthesis when given a list of terms.
7. List the two kinds of wood formed in an annual ring of diameter growth.
8. Name five terms used for classifications of trees by size.
9. Identify tree classifications based on tree crowns when given a drawing of a group of trees.
10. List four classifications of stands for trees.
11. Identify the six forest regions of the United States when given a map drawing.
12. Demonstrate the ability to:
    a. Identify trees using size classifications.
    b. Identify trees using crown classifications.

THE FORESTS
UNIT I

SUGGESTED ACTIVITIES

I. Instructor:

   A. Provide students with objective sheet.

   B. Provide students with information and assignment sheets.

   C. Make transparencies.

   D. Discuss terminal and specific objectives.

   E. Discuss information and assignment sheets.

   F. Arrange field trip to allow students the opportunity to practice identifying trees using size and crown classifications.

   G. Give test.

II. Students:

   A. Read objectives.

   B. Study information sheet.

   C. Complete assignment sheets and turn in to instructor for grading.

   D. Participate in field trip.

   E. Take test.

INSTRUCTIONAL MATERIALS

I. Included in this unit:

   A. Objectives

   B. Information sheet

   C. Transparency masters

      1. TM 1--Main Parts of a Tree

      2. TM 2--The Trunk

3. TM 3--Photosynthesis
4. TM 4--Tree Classification by Tree Crown
5. TM 5--Forest Regions of the United States

D. Assignment sheets

1. Assignment Sheet #1--Identify Trees Using Size Classifications
2. Assignment Sheet #2--Identify Trees Using Crown Classifications

E. Test

F. Answers to test

II. Reference--Allen, Shirley Walter and Grant William Sharpe. *An Introduction to American Forestry.* New York: McGraw-Hill Book Co., Inc.

THE FORESTS
UNIT I

INFORMATION SHEET

I. Terms and definitions

- A. Tree--A woody perennial that attains a height of 8 feet or more, has a single unbranched trunk of at least 2 feet, and is at least 2 inches in diameter at DBH
- B. Perennial--A plant living more than 2 years
- C. DBH (Diameter Breast High)--Measured at 4 1/2 feet from the ground
- D. Softwood--An evergreen tree with needles and scalelike leaves
- E. Hardwood--A broadleaf tree that loses its leaves
- F. Twig--Current year's growth of the stem
- G. Innerbark (Phloem)--That part of the trunk that transports tree food
- H. Cambium--That part of the tree that gives growth and produces more wood
- I. Sapwood (Xylem)--The living part of tree wood that transports water and nutrients to the leaves
- J. Heartwood (Xylem)--The center of the tree that is dead wood
- K. Taproot--The largest root of the root system

  (NOTE: Not all trees have a taproot.)
- L. Lateral root-The side root of the root system
- M. Root tip--The very end of the roots where water and nutrients are absorbed into the tree
- N. Photosynthesis--Process of making food from water, nutrients, carbon dioxide, and sunlight
- O. Annual ring--The layer of wood formed in a season's growth
- P. Seedling--A tree up to 3 feet tall
- Q. Sapling--A tree taller than 3 feet but less than 4 inches DBH
- R. Pole--A tree 4 inches DBH to 11.9 inches DBH
- S. Standard--A tree 12 inches DBH to 23.9 inches DBH

INFORMATION SHEET

- T. Veteran--A tree 24 inches DBH +
- U. Dominant--A tree that receives full sunlight on its crown
- V. Codominant--A tree that receives sunlight on the top of its crown and partially on the sides
- W. Intermediate--A tree that receives sunlight partially on top of its crown
- X. Suppressed--A tree that receives no sunlight
- Y. Stand--A group of trees clustered together based on their age, size, composition, or other criterion
- Z. Forest--The grouping of stands of trees

II. Main parts of a tree (Transparency 1)

- A. Crown
- B. Trunk
- C. Roots

III. Parts of the crown

- A. Leaves
- B. Twigs
- C. Flowers
- D. Fruit

IV. Parts of the trunk (Transparency 2)

- A. Bark
- B. Innerbark
- C. Cambium
- D. Sapwood
- E. Heartwood

V. Parts of the roots (Transparency 1)

- A. Taproot
- B. Lateral root
- C. Root tips

INFORMATION SHEET

VI. Process of photosynthesis (Transparency 3)

- A. Carbon dioxide from the air
- B. Water and nutrients from the soil
- C. Sunlight from sun
- D. Glucose sugar in tree food
- E. Oxygen released to atmosphere

  (NOTE: This process occurs in green leaves.)

- F. Chemical formula:

  Carbon dioxide + water and nutrients + sunlight → glucose sugar + oxygen

VII. Diameter growth (Transparency 2)

- A. Springwood annual ring
- B. Summerwood annual ring

VIII. Tree classifications by size

- A. Seedling
- B. Sapling
- C. Pole
- D. Standard
- E. Veteran

IX. Tree classifications by tree crown (Transparency 4)

- A. D=Dominant
- B. C=Codominant
- C. I=Intermediate
- D. S=Suppressed

X. Stand classifications for trees

- A. Age

  Example: 30 year old stand

INFORMATION SHEET

B. Size

Example: Pole timber stand

C. Composition

1. Pure stand

Example: Shortleaf pine

2. Mixed stand

Example: Pine and hardwood

XI. Forest regions (Transparency 5)

A. Tropical

B. Rocky Mountain

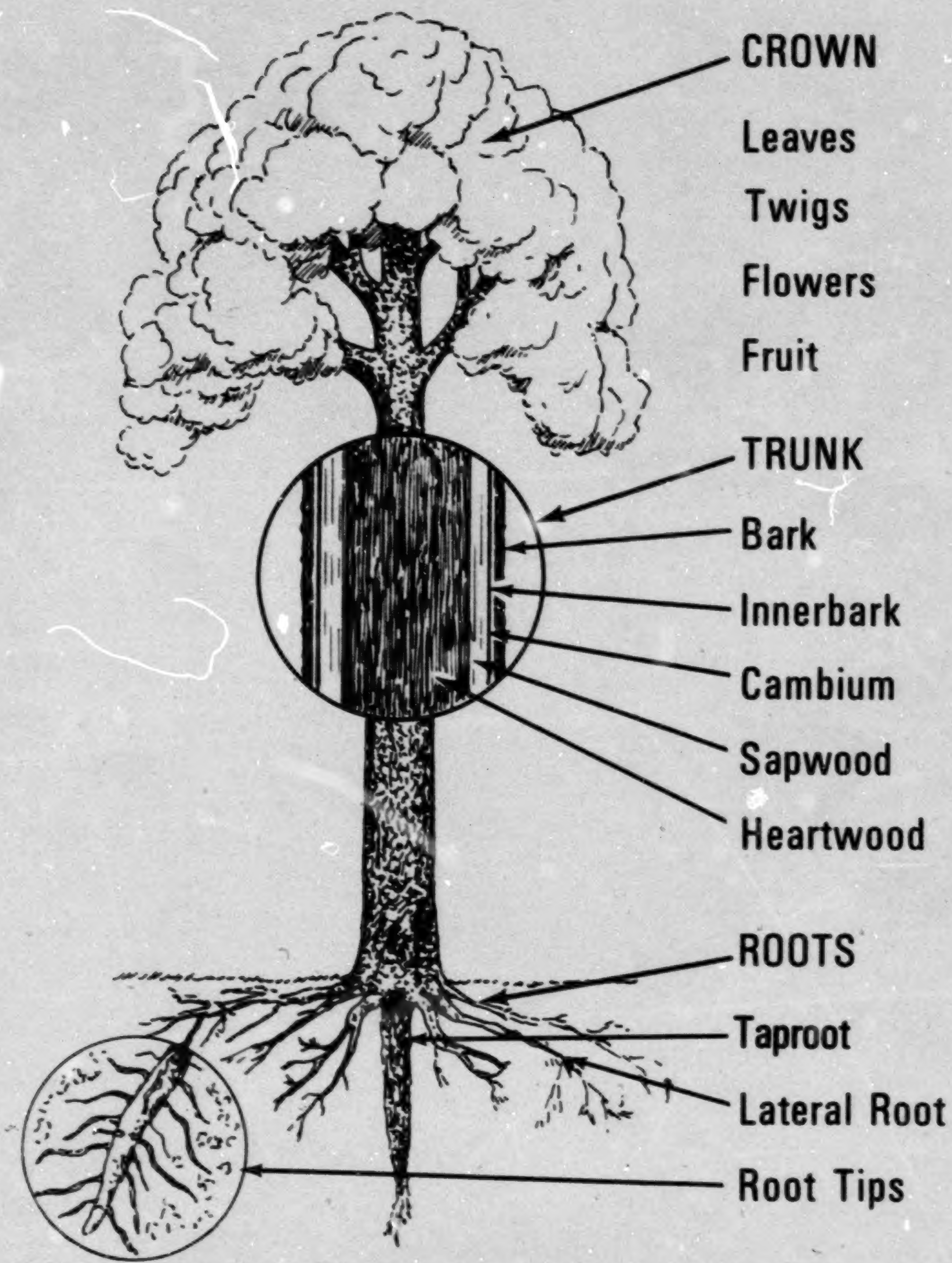
C. Pacific Coast

D. Northern

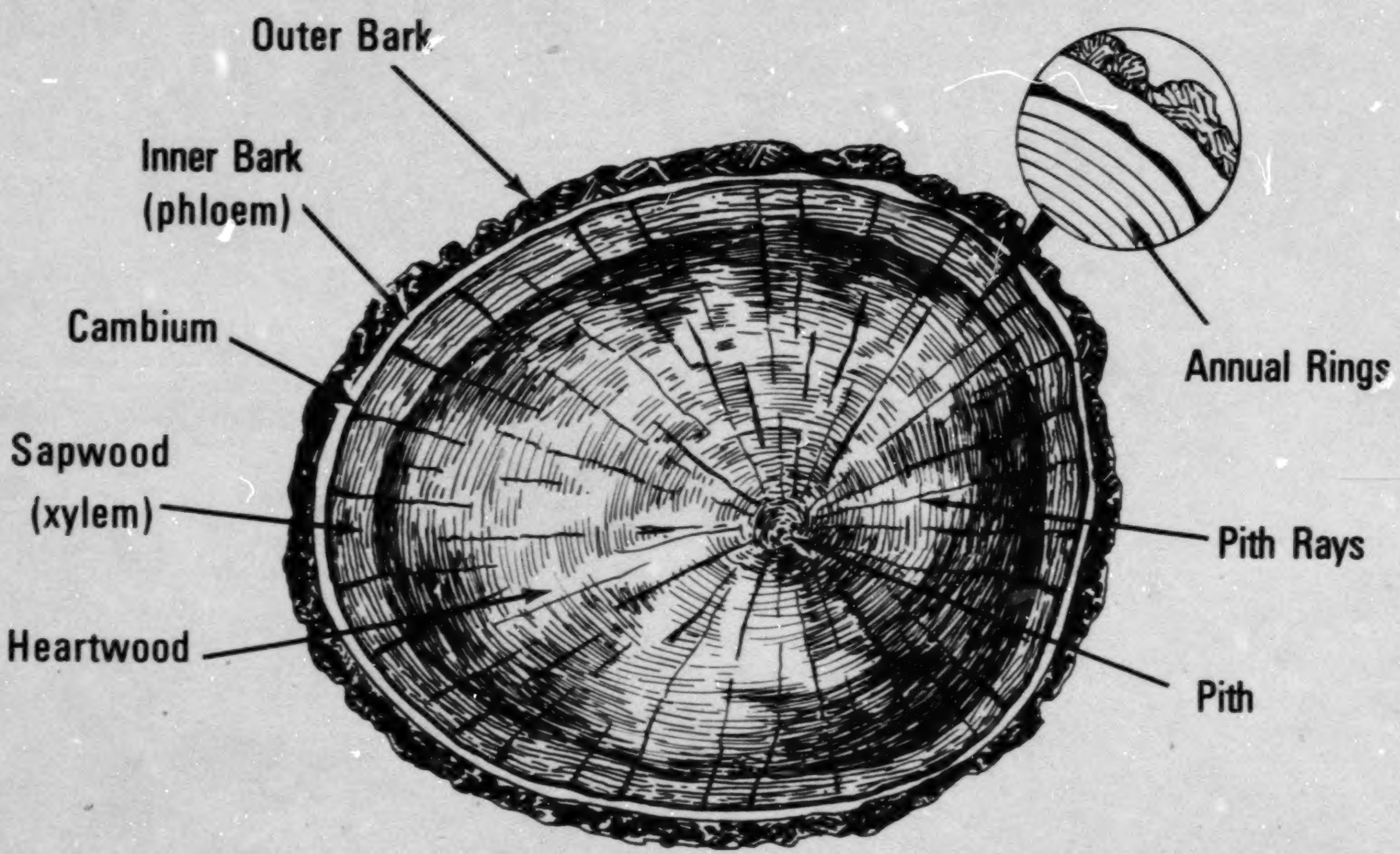
E. Central Hardwood

F. Southern

Main Parts of a Tree


CROWN
Leaves
Twigs
Flowers
Fruit
TRUNK
Bark
Innerbark
Cambium
Sapwood
Heartwood
ROOTS
Taproot
Lateral Root
Root Tips

The Trunk


Outer Bark
Inner Bark (phloem)
Cambium
Sapwood (xylem)
Heartwood
Annual Rings
Pith Rays
Pith

Photosynthesis

The Making of Tree Food

$$CO_2 + H_2O + \text{Sun Light} \xrightarrow[\text{Sugar}]{\text{Glucose}} O_2 \uparrow$$

Carbon Dioxide

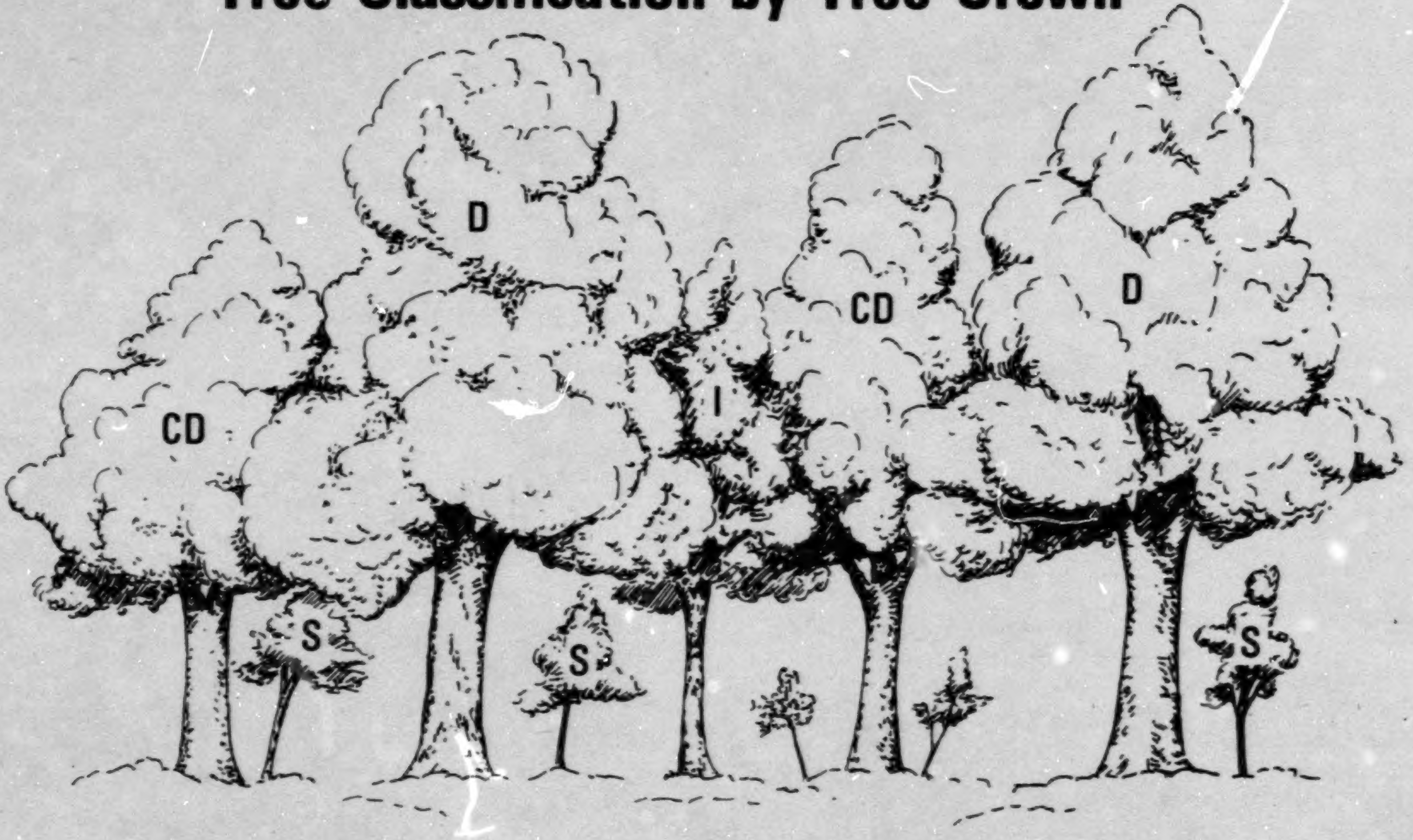
Water and Nutrients

Radiant Energy

Tree Food

Oxygen to the Atmosphere

Tree Classification by Tree Crown



CROWN CLASSIFICATIONS D=Dominant; CD=Codominant; I=Intermediate; S=Suppressed.

Forest Regions of the United States

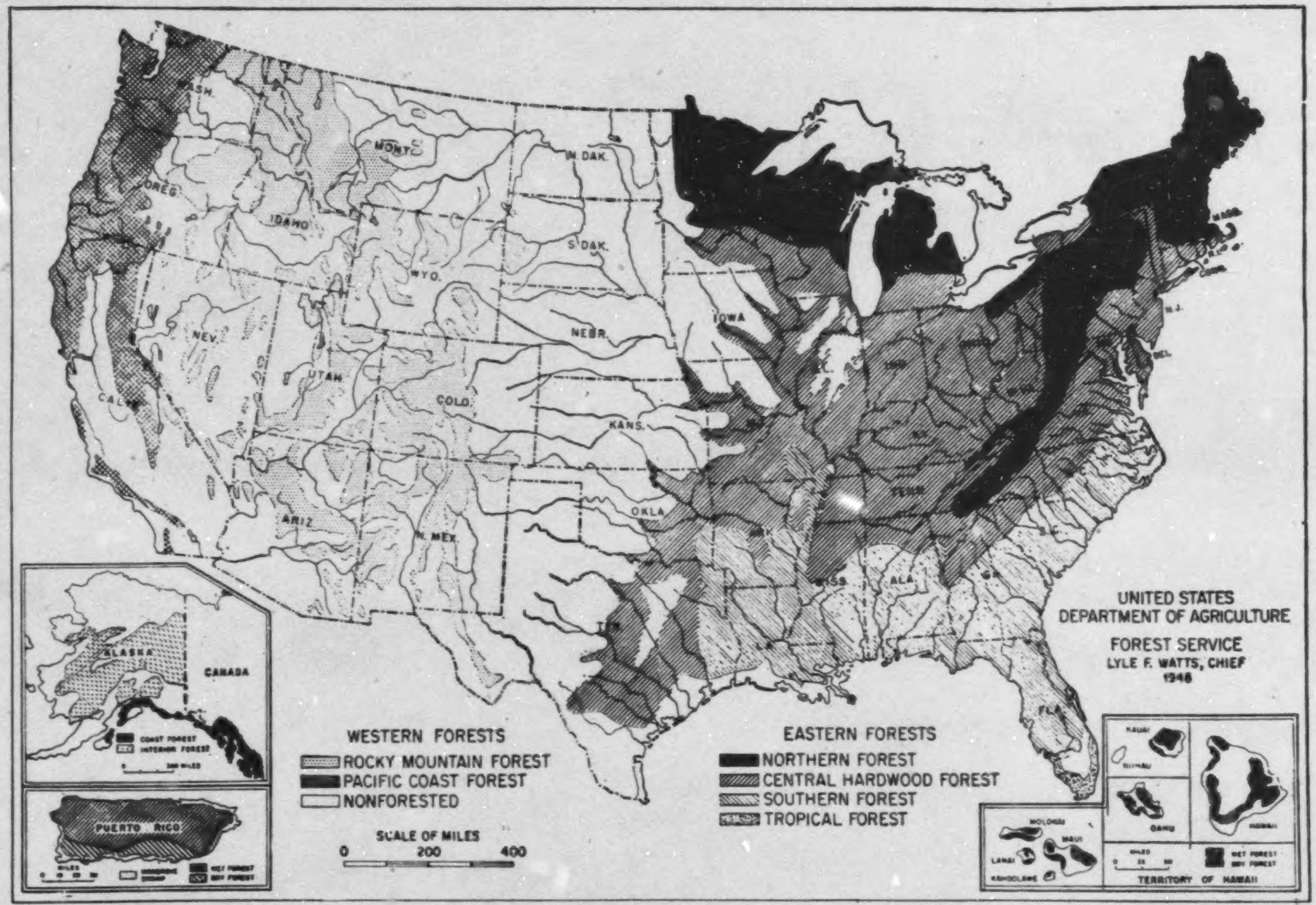

WASH.
MONT.
N. DAK.
OREG.
IDAHO
S. DAK.
WYO.
IOWA
NEBR.
NEV.
UTAH
CALIF.
COLO.
KANS.
OKLA.
ARIZ.
N. MEX.
TENN.
MISS.
ALA.
FLA.
MASS.
CONN.
N.J.
DEL.
ALASKA
CANADA
COAST FOREST
INTERIOR FOREST
PUERTO RICO
WET FOREST
DRY FOREST
WESTERN FORESTS
ROCKY MOUNTAIN FOREST
PACIFIC COAST FOREST
NONFORESTED
SCALE OF MILES
0
200
400
EASTERN FORESTS
NORTHERN FOREST
CENTRAL HARDWOOD FOREST
SOUTHERN FOREST
TROPICAL FOREST
UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE
LYLE F. WATTS, CHIEF
1948
KAUAI
NIIHAU
OAHU
MOLOKAI
MAUI
LANAI
KAHOOLAWE
HAWAII
WET FOREST
DRY FOREST
TERRITORY OF HAWAII

FIG. 3-1. A map showing the natural forest regions of the United States. The Alaskan Forest is seen in the inset. (*Courtesy of U.S. Forest Service.*)

THE FORESTS
UNIT I

ASSIGNMENT SHEET #1--IDENTIFY TREES USING SIZE CLASSIFICATIONS

Identify trees indicated by the instructor as to:

Seedling - Up to 3 feet tall
Sapling - 3 feet to less than 4 inches DBH
Pole - 4 inches DBH to 11.9 inches DBH
Standard - 12 inches DBH to 23.9 inches DBH
Veteran - 24 inches DBH +

Place an "X" in the blank indicating the proper identification. When finished turn in to the instructor for evaluation.

Tree No.	Seedling	Sapling	Pole	Standard	Veteran
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					
10.					
11.					
12.					
13.					
14.					
15.					

THE FORESTS
UNIT I

ASSIGNMENT SHEET #2--IDENTIFY TREES USING CROWN CLASSIFICATIONS

Identify trees indicated by the instructor as to:

Dominant--Receives full sunlight on its crown
Codominant--Receives sunlight on top and partially on the sides
Intermediate--Receives sunlight partially on top of crown
Suppressed--Receives no sunlight

Place an "X" in the blank indicating the proper identification. When finished, turn in to the instructor for evaluation.

Tree No.	Dominant	Codominant	Intermediate	Suppressed
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				
11.				
12.				
13.				
14.				
15.				

THE FORESTS
UNIT I

TEST

1. Match the terms on the right to the correct definition.

______a. A woody perennial that attains a height of 8 feet or more, has a single unbranched trunk of at least 2 feet, and is at least 2 inches in diameter at DBH

______b. A plant living more than 2 years

______c. Measured at 4 1/2 feet from the ground

______d. An evergreen tree with needles and scalelike leaves

______e. A broadleaf tree that loses its leaves

______f. Current year's growth of the stem

______g. That part of the trunk that transports tree food

______h. That part of the tree that gives growth and produces more wood

______i. The living part of tree wood that transports water and nutrients to the leaves

______j. The center of the tree that is dead wood

______k. The largest root of the root system

______l. The side root of the root system

______m. The very end of the roots where water and nutrients are absorbed into the tree

______n. Process of making food from water, nutrients, carbon dioxide, and sunlight

______o. The layer of wood formed in a season's growth

1. Softwood
2. Cambium
3. Taproot
4. Veteran
5. Pole
6. Stand
7. Seedling
8. Tree
9. Standard
10. Sapling
11. Lateral root
12. DBH (Diameter Breast High)
13. Innerbark (Phloem)
14. Codominant
15. Annual ring
16. Root tip
17. Suppressed
18. Perennial
19. Twig
20. Photosynthesis
21. Forest
22. Sapwood (Xylem)

______p. A tree up to 3 feet tall

______q. A tree taller than 3 feet but less than 4 inches DBH

______r. A tree 4 inches DBH to 11.9 inches DBH

______s. A tree 12 inches DBH to 23.9 inches DBH

______t. A tree 24 inches DBH +

______u. A tree that receives full sunlight on its crown

______v. A tree that receives sunlight on the top of its crown and partially on the sides

______w. A tree that receives sunlight partially on top of its crown

______x. A tree that receives no sunlight

______y. A group of trees clustered together based on their age, size, composition, or other criterion

______z. The grouping of stands of trees

23. Intermediate
24. Dominant
25. Hardwood
26. Heartwood (Xylem)

2. List the three main parts of a tree.

a.

b.

c.

3. List the four parts of tree crowns.

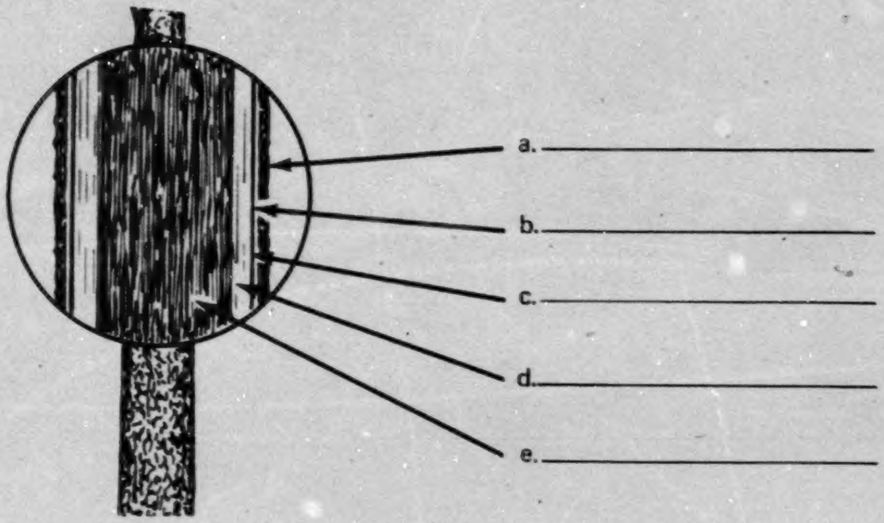
a.

b.

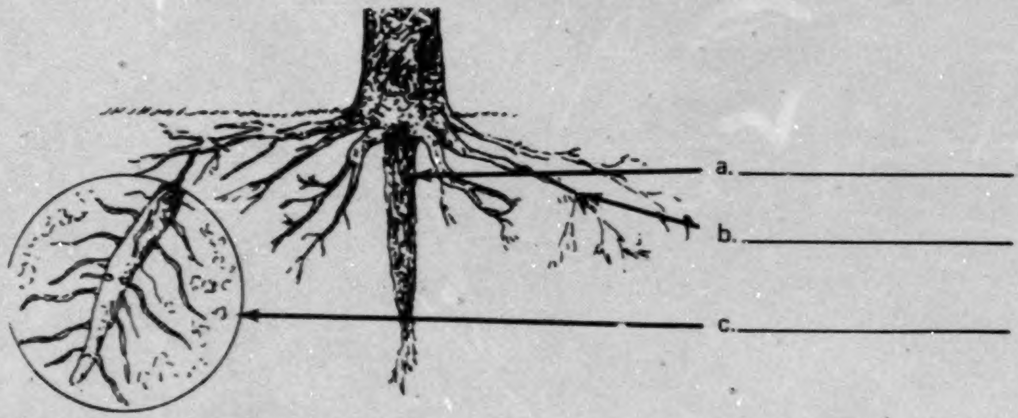
c.

d.

4. Label the parts of this tree trunk below.



5. Label the parts of this tree root system below.



6. Describe the general process for photosynthesis from the list of terms given below.

sunlight
glucose sugar
water and nutrients
carbon dioxide
oxygen

a. __________ + b. __________ and __________ + c. __________ →

d. __________ + e. __________

7. List the two kinds of wood formed in an annual ring of diameter growth.

a.

b.

8. Name the five terms used for classifications of trees by size.

a.

b.

c.

d.

e.

9. Identify tree classifications based on tree crowns from the drawing given below by placing a "D" for dominant, "CD" for codominant, "I" for intermediate, and "S" for suppressed.

a. __________

b. __________

c. __________

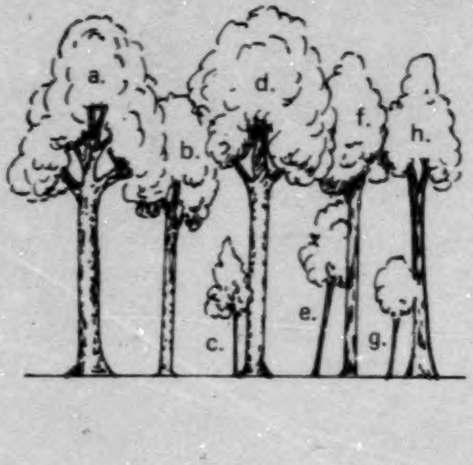
d. __________

e. __________

f. __________

g. __________

h. __________



10. List four classifications of stands for trees.

a.

b.

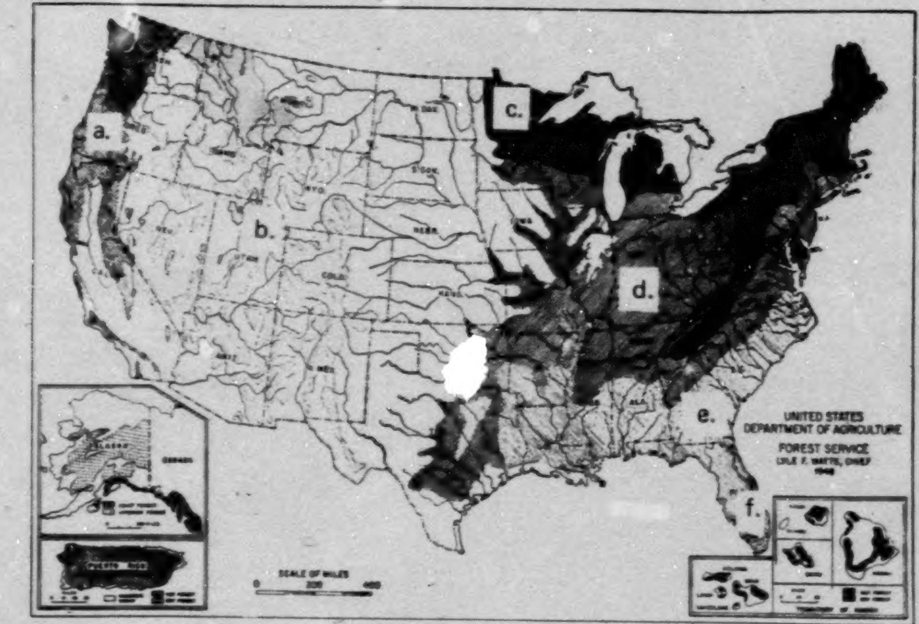
c.

1)

2)

11. Identify the six forest regions of the United States shown on this map.

a.	d.
b.	e.
c.	f.


a.
b.
c.
d.
e.
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LYLE F. WATTS, CHIEF
SCALE OF MILES
0
200
400

12. Demonstrate the ability to:

a. Identify trees using size classifications.

b. Identify trees using crown classifications.

THE FORESTS
UNIT I

ANSWERS TO TEST

1.
a. 8
b. 18
c. 12
d. 1
e. 25
f. 19
g. 13
h. 2
i. 22
j. 26
k. 3
l. 11
m. 16
n. 20
o. 15
p. 7
q. 10
r. 5
s. 9
t. 4
u. 24
v. 14
w. 23
x. 17
y. 6
z. 21

2.
a. Crown
b. Trunk
c. Roots

3.
a. Leaves
b. Twigs
c. Flowers
d. Fruit

4.
a. Bark
b. Innerbark
c. Cambium
d. Sapwood
e. Heartwood

5.
a. Taproot
b. Lateral root
c. Root tips

6.
a. Carbon dioxide
b. Water and nutrients

- c. Sunlight
- d. Glucose sugar
- e. Oxygen

7.
- a. Springwood annual ring
- b. Summerwood annual ring

8.
- a. Seedling
- b. Sapling
- c. Pole
- d. Standard
- e. Veteran

9.
- a. D
- b. I
- c. S
- d. D
- e. S
- f. C
- g. S
- h. C

10.
- a. Age
- b. Size
- c. Composition
  - 1) Pure
  - 2) Mixed

11.
- a. Pacific Coast
- b. Rocky Mountain
- c. Northern
- d. Central Hardwood
- e. Southern
- f. Tropical

12. Performance skills will be evaluated to the satisfaction of the instructor.

IDENTIFYING OKLAHOMA TREES
UNIT I

TERMINAL OBJECTIVE

After completion of this unit, the student should be able to identify leaves by composition, shape, margin, and arrangement. He should be able to use these terms with a key to identify Oklahoma trees. This knowledge will be evidenced through demonstration and by scoring eighty-five percent on the unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms associated with identifying Oklahoma trees to the correct definition.
2. Distinguish between the characteristics for gymnosperms and angiosperms.
3. Label the parts of a simple leaf on a given diagram.
4. Name the four types of veins found in tree leaves.
5. Match the type of compound leaf to the correct definition.
6. Label leaf shapes when given a list of terms.
7. Label leaf margins when given a list of terms.
8. Identify leaf arrangements.
9. Demonstrate the ability to identify trees using a key.

IDENTIFYING OKLAHOMA TREES
UNIT I

SUGGESTED ACTIVITIES

I. Instructor:

- A. Provide students with objective sheet.
- B. Provide students with information and assignment sheets.
- C. Discuss information and assignment sheets.
- D. Discuss terminal and specific objectives.
- E. Arrange field trips to allow students to collect and identify leaves by shape and margin. Also, provide students with an opportunity to use a key to identify tree species and leaf arrangements.
- F. Give test.

II. Students:

- A. Read objectives.
- B. Study information sheet.
- C. Participate in field trips.
- D. Complete assignment sheets.
- E. Take test.

INSTRUCTIONAL MATERIALS

I. Included in this unit:

- A. Objectives
- B. Information sheet
- C. Transparency masters
  1. TM 1--Leaf Parts
  2. TM 2--Simple and Compound Leaves
  3. TM 3--Leaf Shapes
  4. TM 4--Leaf Shapes (Continued)

   5. TM 5--Leaf Margins
   6. TM 6--Leaf Margins (Continued)
   7. TM 7--Leaf Arrangements

D. Assignment sheets

   1. Assignment Sheet #1--Identify Leaf Shapes and Margins
   2. Assignment Sheet #2--Identify Leaf Arrangements and Tree Species Using a Key

E. Test

F. Answers to test

II. References:

A. Phillips, George R., Frank J. Gibbs, and Wilbur R. Mattoon. *Forest Trees of Oklahoma.* Oklahoma City, Oklahoma; State Forestry Division.

B. Harlow, William H. and Ellwood S. Harrar. *Textbook of Dendrology*. New York: McGraw-Hill Book Co.

IDENTIFYING OKLAHOMA TREES
UNIT I

INFORMATION SHEET

I. Terms and definitions

A. Fruit--The seed bearing product of a plant

B. Gymnosperm--Plant bearing naked seeds

C. Evergreen--Always green; year-round

D. Resin duct--Minute opening in wood filled with resin

E. Cone--A fruit formed of overlapping scales

F. Angiosperm--Plant bearing enclosed seeds

G. Deciduous--Leaves fall each autumn

H. Pore--A cell opening in angiosperms; occasionally visible to the naked eye

I. Leaf composition--Refers to compound leaves

J. Simple leaf--One blade

(NOTE: A blade is the expanded portion of a leaf.)

K. Compound leaf--Several leaflets to form a leaf

L. Key--A system of grouping species to be readily identified using leaves and other characteristics

M. Leaf arrangement--The location of leaves on a stem

N. Sinus--The separation between lobes

O. Dichotomus--Branching by forking in pairs

P. Node--The point on a stem where a leaf is found

II. Characteristics of gymnosperms and angiosperms

A. Gymnosperms--Open seeded

1. Generally evergreen

2. Called conifers or softwoods

3. Wood has no pores, but resin ducts sometimes do

INFORMATION SHEET

4. Leaves are needlelike, scalelike, or awl-like
5. Fruit is a woody or fleshy cone

B. Angiosperms--Closed seeded

1. Generally deciduous
2. Called broadleaf or hardwoods
3. Wood has pores and no resin ducts
4. Leaves are broadened; expanded blades
5. Fruit is dry or fleshy and encloses the seed

III. Simple leaf parts (Transparency 1)

A. Veins--Conduction system

B. Midrib--Main vein extended from twig through a petiole

C. Blade--Expanded portion of a leaf

D. Petiole--Stalk of a leaf

E. Bud--New shoot or flower; also indicates the beginning point of a leaf

IV. Types of veins

A. Pinnate

B. Palmate

C. Arcuate

D. Closed

V. Compound leaves (Transparency 2)

A. Odd-pinnate--Has a terminal leaflet

B. Even-pinnate--Even number of leaflets

C. Pinnately trifoliate--Three leaflets

D. Palmate--All leaflets from the same point on the petiole

E. Palmately trifoliate--Three leaflets from same point on the petiole

F. Bipinnate--Second division of leaflets

G. Tripinnate--Third division of leaflets

INFORMATION SHEET

VI. Leaf shapes (Transparencies 3 and 4)

A. Acicular--Needlelike

B. Scalelike--Small, short, sharp-pointed

C. Linear--Long and narrow

D. Oblong--Long and wide

E. Lanceolate--Lance-shaped

F. Oblanceolate--Inverse lance-shaped

G. Ovate--Egg-shaped

H. Obovate--Inverse egg-shaped

I. Elliptical--Shaped like an ellipse

J. Oval--A broad ellipse

K. Orbicular--Circular

L. Reniform--Kidney-shaped

M. Cordate--Heart-shaped

N. Obcordate--Inverse heart-shaped

O. Cuneate--Wedge shaped

P. Deltoid--Triangular

Q. Obdeltoid--Inverse triangular

R. Rhomboid--Diamond shaped

S. Spatulate--Spatula shaped

T. Sagittate--Arrowhead

U. Hastate--Spearhead

V. Peltate--Shield shaped

W. Subulate--Expanded point

VII. Leaf margins (Transparencies 5 and 6)

A. Revolute--Turned under

B. Entire--Smooth edge

INFORMATION SHEET

C. Repand--Wavy

D. Sinuate--Very wavy

E. Crenate--Rounded teeth

F. Crenulate--Finely rounded teeth

G. Doubly crenate--Large and fine round teeth

H. Dentate--Sharp teeth pointed out

I. Denticulate--Fine dentate teeth

J. Serrate--Sharp teeth turned up

K. Serrulate--Finely serrated

L. Doubly serrate--Coarse and fine serrations

M. Divided--Sinus extends to midrib

N. Lobed--Rounded sinus

O. Pinnately lobed--Lobing from midrib

P. Palmately lobed--Lobing from base of leaf

Q. Cleft--Narrow, sharp sinuses

R. Parted--Cleft extends to midrib

VIII. Leaf arrangements (Transparency 7)

A. Alternate--One leaf at a node

B. Opposite--Two leaves at a node

C. Whorled--More than two leaves at a node

IX. Using a tree key

A. Generally dichotomus

B. Key includes:

1. Choice of gymnosperms or angiosperms
2. Choice of leaf arrangement
3. Choice of type of leaf composition
4. Continued choice until a species of tree is reached

SUMMER KEY TO THE GENERA OF OKLAHOMA TREES

Based Primarily on Leaves and Fruit

1. Leaves needle like, scale like or awl-shaped .... **Gymnosperms**
2. Leaves alternate on the stem or in fascicles; fruit a cone.
3. Leaves persistent (in fascicles of two to five) .... **Pinus** (Pines)
3. Leaves and branchlets deciduous (alternate) .... **Taxodium** (Cypress)
2. Leaves opposite or whorled, scale like or awl-shaped; fruit berry-like with 1 to 4 seeds .... **Juniperus** (Cedars)

1. Leaves broad (net veined) .... **Angiosperms**
2. Leaves opposite.
3. Leaves simple.
4. Leaves palmately lobed .... **Acer** (Maple)
4. Leaves without lobes.
5. Leaf margins serrate.
6. Buds and sometimes midrib rusty tomentose .... **Viburnum** (Black haw)
6. Not as above.
7. Leaves serrate above the middle, teeth incurved; fruit blue purple, ripening and falling in early summer .... **Forestiera** (Swamp privet)
7. Leaves serrate the full length of margin; fruit ripening in fall, with scarlet aril .... **Evonymous** (Wahoe)
5. Leaf margins entire.
6. Leaves 7 to 12 inches in length
7. Leaves usually in whorls of 3, tip tapering; fruit a long capsule **Catalpa**
7. Leaves strictly opposite, tip rounded; fruit an ovate capsule; (pith chambered) .... **Paulownia** (Princess tree)
6. Leaves less than 7 inches in length
7. Leaves with lateral veins curving toward the apex; petiole grooved; fruit red or white .... **Cornus** (Dogwood)
7. Leaves and fruit not as above.
8. Leaves often in whorls of 3 (fruit in ball like heads; usually found at water's edge) .... **Cephalanthus** (Buttonbush)
8. Leaves strictly opposite (coarsely net veined below; white flowers in clusters of 3) .... **Chionanthus** (Old man's beard)
3. Leaves compound
4. Leaves palmately compound (5 to 7 leaflets) .... **Aesculus** (Buckeye)
4. Leaves pinnately compound.
5. Leaves with 3 leaflets.
6. Leaves finely serrate; fruit bladder like .... **Staphylea** (Bladdernut)
6. Leaves coarsely serrate or lobed; fruit 2 samaras joined **Acer Negundo** (Box elder)
5. Leaves with more than 3 leaflets.
6. Leaflets 3 to 5, lobed or coarsely serrate; fruit 2 samaras joined **Acer Negundo** (Box elder)
6. Leaflets 5 to 11, margins entire or finely serrated; fruit a free samara **Fraxinus** (Ash)
2. Leaves alternate
3. Leaves simple (If not, see page 17.)
4. Leaves lobed
5. Leaves pinnately lobed, or not distinctly palmately lobed except sometimes in Morus and Sassafras.
6. Sap in leaves and bark distinctly milky; leaves with 3 distinct veins from base .... **Morus** (Mulberry)
6. Not as above.
7. Wood, bark and crushed leaves spicy aromatic; (leaves with 2 or 3 or no lobes) .... **Sassafras** (Sassafras)

7. Not as above.
8. Thorns present; fruit fleshy.
9. Thorns usually with lateral buds; fruit an apple .... **Malus** (Crab apple)
9. Thorns without lateral buds; fruit with stony carpels .... **Crataegus** (Hawthorn)
8. Thorns absent; fruit an acorn; (buds clustered at ends of twigs; pith star-shaped) .... **Quercus** (Oak)
9. Leaf lobes bristle tipped (individual leaves often entire); bark dark; wood pores open .... **Black oaks**
9. Leaf lobes entire or gland tipped; bark grey; wood pores closed with tyloses .... **White oaks**
5. Leaves palmately lobed.
6. Leaves star-shaped, lobes finely serrate .... **Liquidambar** (Sweet gum)
6. Leaves broadly ovate, lobes not finely serrate; (buds inclosed by the base of the petiole; outer bark of upper branches and young trunks scaling off leaving smooth white bark) .... **Platanus** (Sycamore)
4. Leaves not lobed.
5. Leaf margins entire
6. Leaves persistent, (at least during part of winter).
7. Leaves aromatic, under side with yellow resin dots .... **Myrica** (Wax myrtle)
7. Leaves not aromatic or resin dotted.
8. Margins more or less revolute; bark reddish. .... **Vaccinium** (Tree huckleberry)
8. Margins sometimes serrated, leaves sweet and yield a yellow dye. **Symplocos** (Horse sugar)
6. Leaves deciduous.
7. Sap in leaves and bark milky; (spines usually present; fruit orange-like) **Maclura** (Bois d'Arc)
7. Sap in leaves and bark not milky, or at least not conspicuously so.
8. Wood, bark and crushed leaves spicy aromatic, leaves often 2 or 3 lobed; fruit a blue berry with a persistent scarlet calyx .... **Sassafras**
8. Not as above.
9. Leaves distinctly cordate .... **Cercis** (Redbud)
9. Leaves not distinctly cordate.
10. Stipules and stipule scars encircling the twig .... **Magnolia** (Cucumber tree)
10. Stipules and stipule scars (if present) not encircling twig.
11. Leaves 3-veined from base; fruit a small orange or yellow drupe; bark warty; (pith often chambered) .... **Celtis** (Hackberry)
11. Leaves not 3-veined from base; fruit various; bark not warty.
12. Buds in clusters at end of twig; (fruit an acorn; pith star-shaped) **Quercus sp.** (Oaks)
12. Buds at end of twig single.
13. Pith partitioned by woody plates.
14. Leaves often 10 to 12 inches in length, (disagreeable odor when crushed) .... **Asimina** (Paw paw)
14. Leaves less than 6 inches in length, (crowded at ends of lateral branches) .... **Nyssa** (Sour gum)
13. Pith not partitioned by woody plates.
14. Pith chambered (at least in most branches; leaves oblong ovate; fruit pulpy with few or many flat seeds .... **Diospyros** (Persimmon)
14. Pith not chambered.
15. Leaves often fascicled on lateral branches; spines present; leaves less than 3 inches in length .... **Bumelia** (Chittamwood)
15. Leaves never fascicled; branches not spinescent; leaves more than 3 inches in length (brilliantly colored in fall) .... **Cotinus** (Smoke tree)
5. Leaf margin toothed or serrate.
6. Leaves persistent.
7. Leaves aromatic, resin dotted .... **Myrica** (Wax myrtle)
7. Leaves not as above.
8. Leaves sharp pointed, (spiny toothed, rarely entire) **Ilex opaca** (Holly)

9-8

8. Leaves not as above.

9. Leaves rounded at end, small, glisten **Ilex vomitoria** (Yaupon)

9. Leaves 5 to 6 inches long, sweet, yield a yellow dye **Symplocos tinctoria** (Horse sugar)

6. Leaves deciduous.

7. Sap in leaves and bark milky . . . . **Morus** (Mulberry)

7. Sap in leaves and bark not milky.

8. Buds clustered at end of twig; pith star shaped **Quercus** (Oaks)

8. Not as above.

9. Buds with a single hood-like scale **Salix** (Willow)

9. Buds with more than 1 scale.

10. Buds distinctly stalked.

11. Leaves coarsely toothed or with wavy margins; seeds in a 2-celled capsule **Hamamelis** (Witch hazel)

11. Leaves with finely serrate, wavy margins; nutlets in a cone like structure, (pith 3 angled) **Alnus** (Alder)

10. Buds not distinctly stalked.

11. Leaf blades about as broad as long.

12. Petioles flattened; leaves crenate-serrate, base equal, buds resinous **Populus** (Poplar)

12. Petiole not flattened; leaves sharply serrate, bases oblique; buds one sided; (fruit attached to a leaf like wing) **Tilia** (Basswood)

11. Leaf blades longer than broad.

12. Leaves obliquely rounded at base.

13. Pith usually chambered; bark with warty ridges, (fruit an ovoid drupe) . . . . **Celtis** (Hackberry)

13. Pith not chambered; bark not warty.

14. Buds evident; fruit a samara, leaves usually doubly serrate **Ulmus** (Elms)

14. Buds minute; fruit a drupe enclosed in a withered calyx; leaves crenate-serrate **Planera** (Water elm)

12. Leaves not distinctly oblique at base.

13. Teeth an extension of the primary veins, no teeth between.

14. Bark smooth, grey; 2 triangular nuts in a prickly burr **Fagus** (Beech)

14. Bark ridged; a single nut in a spiny burr **Castanea** (Chinquapin)

13. Teeth not as above.

14. Pith chambered.

15. Fruit an orange, reddish or blue drupe; (bark warty) **Celtis** (Hackberry)

15. Fruit 4-winged; (flowers bell-like) **Halesia** (Silver bell)

14. Pith not chambered.

15. Glands on upper part of petiole (often inconspicuous without magnifying glass; fruit a fleshy drupe) **Prunus** (Plum and cherry)

15. Glands not present on upper part of petiole.

16. Thorns present.

17. Thorns usually with lateral buds, bearing leaves and flowers; fruit an apple . . . . **Malus** (Crab apple)

17. Thorns without leaf or flower buds; fruit with stony carpels **Crataegus** (Hawthorn)

16. Thorns absent.

17. Leaves on short spur-like branchlets.

18. Bark on young trunks and old branches peeling in thin paper-like layers . . . . **Betula** (Birch)

18. Bark never peeling as above.

19. Fruit red or orange, persistent; pedicels ⅛ inch in length on short stout spurs; calyx not evident **Ilex** (Deciduous holly)

19. Fruit red or orange; not persistent; pedicels long, slender, not on spurs; calyx evident **Crataegus** (Hawthorn)

17. Leaves not on short spur-like branches.

18. Bark shreddy; (fruit inclosed in bladder-like membranes) . . **Ostrya** (Ironwood)

18. Bark smooth or scaly but not shreddy.

19. Fruit a nut on a leaf-like bract; (bark smooth grey over fluted trunks) . . . . **Carpinus** (Blue beech)

19. Fruit fleshy.

20. Leaves oblong; obscure, incurved teeth . . . . **Rhamnus** (Indian cherry)

20. Leaves not oblong, but are serrate.

21. Bark smooth grey or black and grey mottled, except on old trunks . . . . **Amelanchier** (Shadbush)

3. Leaves compound.

4. Leaves twice or three times pinnate.

5. Pith large, salmon colored, soft; leaflets entire . . . . **Gymnocladus** (Coffee tree)

5. Not with the above combination.

6. Base of petiole sheathing stem . . . . **Aralia** (Hercules club)

6. Not as above.

7. Leaflets crenate or serrate, 4 to 7 pairs of pinnae; (pith often pinkish, but hard and small) . . . . **Gleditsia** (Honey locust)

7. Leaflets entire, 2 or sometimes 4 pinnae; (stipular spines present) . . . . **Prosopis** (Mesquite)

4. Leaves once pinnate.

5. Leaves with 3 leaflets . . . . **Ptelia** (Wafer ash)

5. Leaves with more than 3 leaflets.

6. Pith chocolate colored, chambered . . . . **Juglans** (Walnut)

6. Pith not as above.

7. Buds hidden within or under petiole.

8. Base of petiole hollow, entirely surrounding bud.

9. Leaflets entire, (distinctly alternate) . . . . **Cladrastis** (Yellow-wood)

9. Leaflets serrate; (sap milky) . . . . **Rhus glabra** (Smooth sumac)

8. Base of petiole not hollow, although the buds may be hidden beneath it.

9. Branches unarmed.

10. Leaflets serrate or crenate, sometimes twice pinnate . . . . **Gleditsia** (Honey locust)

10. Leaflets entire.

11. Leaflets oval . . . . **Robinia** (Black locust)

11. Leaflets acute . . . . **Sophora** (Coral bean)

9. Branches armed.

10. Spines branched; leaves on the same tree often 2 or 3 times pinnate **Gleditsia** (Honey locust)

10. Spines unbranched; leaves never twice pinnate . . . . **Robinia** (Black locust)

7. Buds not hidden, but in evidence.

8. Leaves and twigs with prickles . . . . **Zanthoxylum** (Prickly ash)

8. Leaves and twigs without prickles.

9. Basal lobes of leaflets with glands, rank odor to crushed leaves . . . . . **Ailanthus** (Tree of Heaven)

9. Not as above.

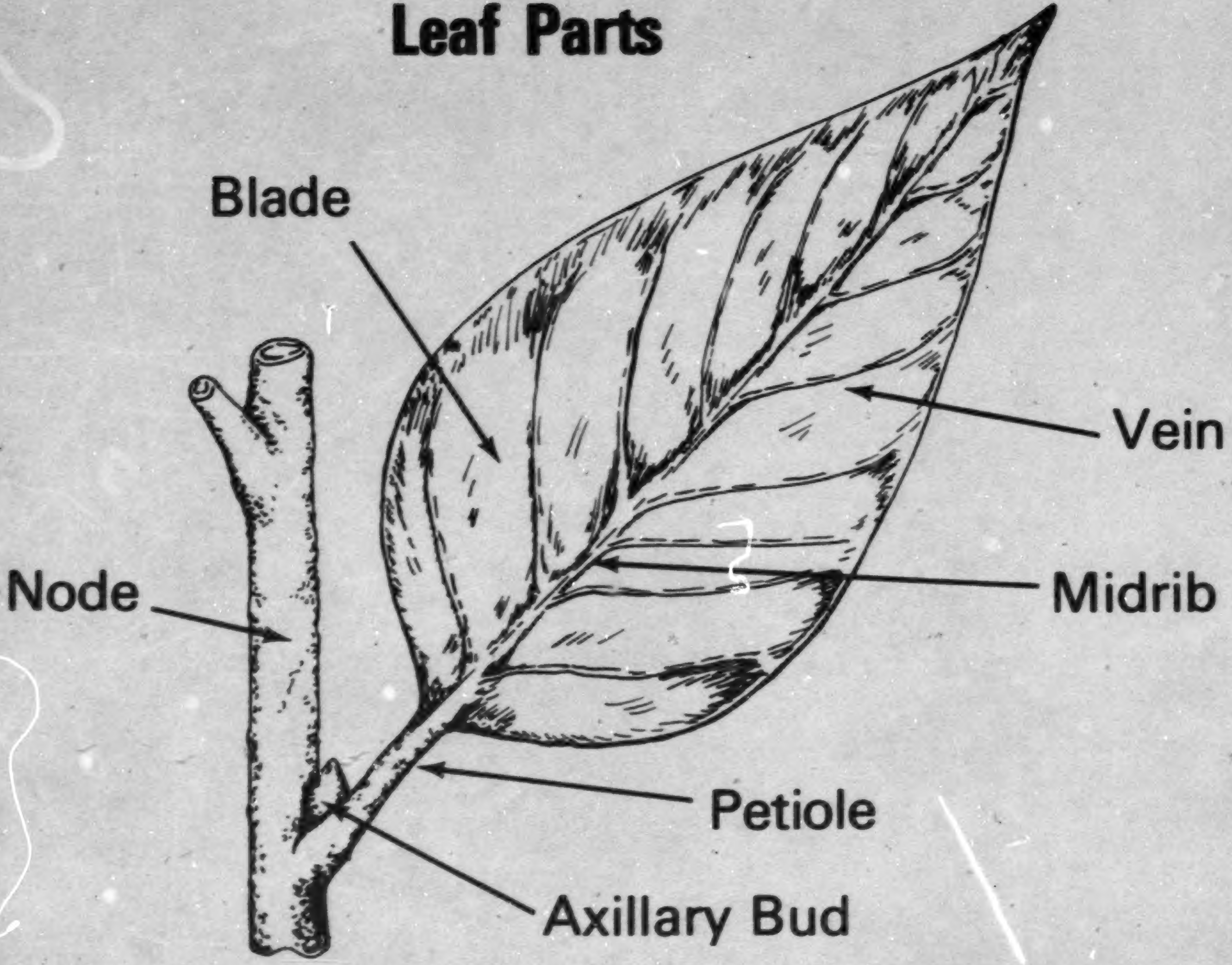
10. Rachis winged . . . . **Rhus copallina** (Winged sumac)

10. Not as above.

11. Leaflets serrate . . . . **Carya** (Hickory)

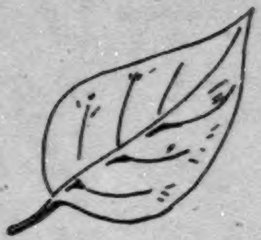
11. Leaflets entire . . . . **Sapindus** (China tree)

Leaf Parts

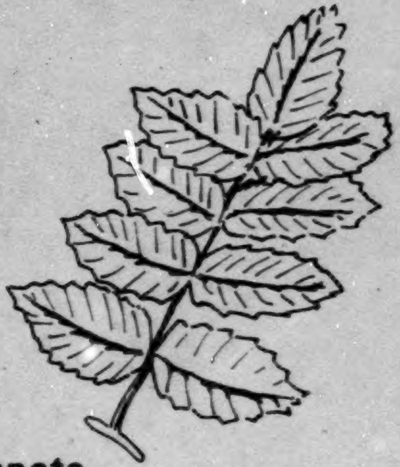

Blade
Vein
Node
Midrib
Petiole
Axillary Bud

Simple and Compound Leaves

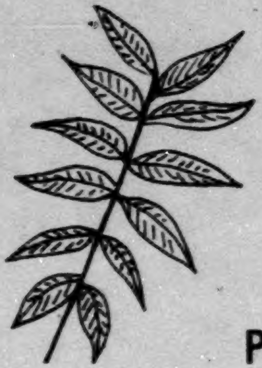
Simple Leaf



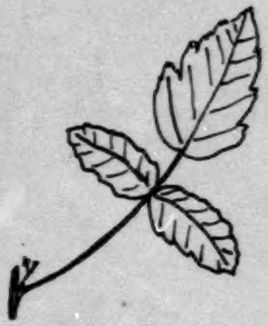
Compound Leaves



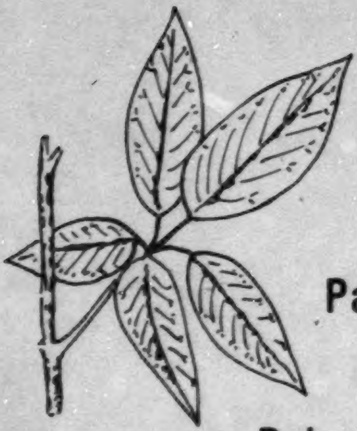
Odd-Pinnate



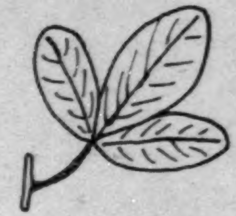
Even-Pinnate



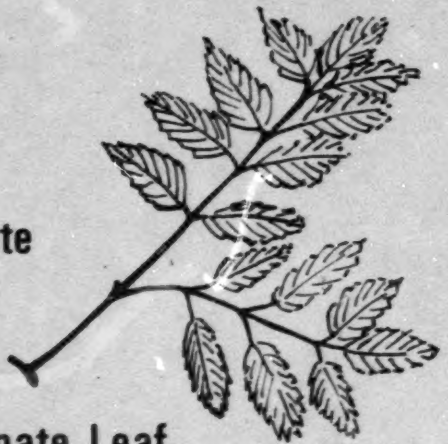
Pinnately Trifoliate



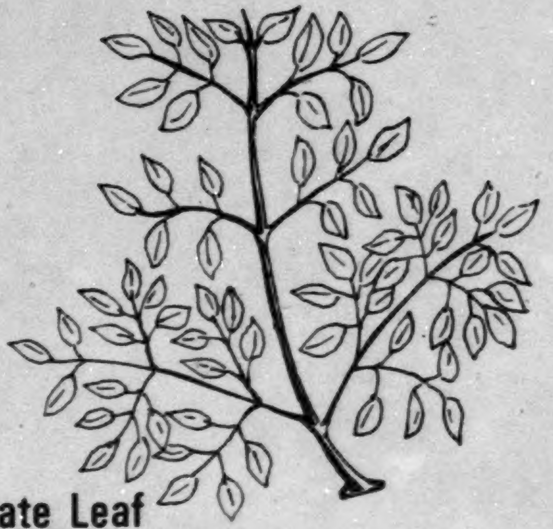
Palmate



Palmately Trifoliate

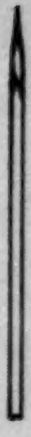


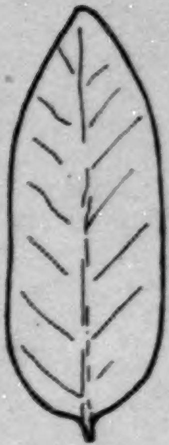
Bipinnate Leaf

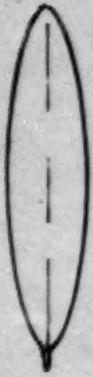


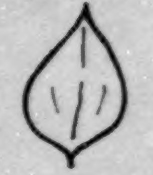
Tripinnate Leaf

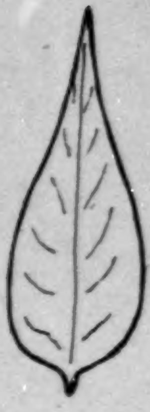
Leaf Shapes

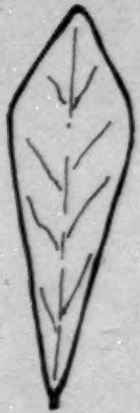

Acicular

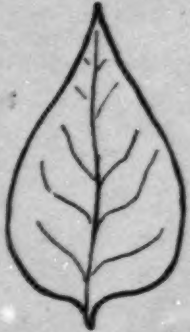

Oblong

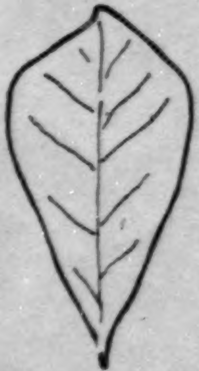

Linear


Scalelike


Lanceolate


Oblanceolate


Ovate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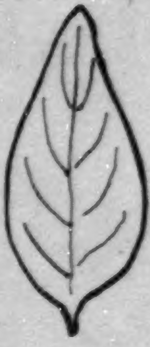
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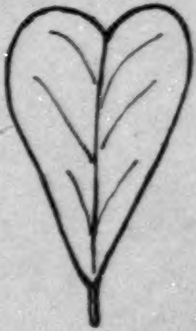
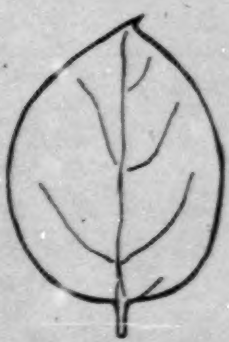

Obcordate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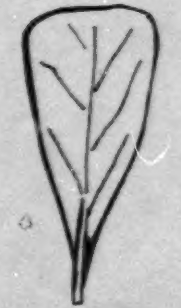
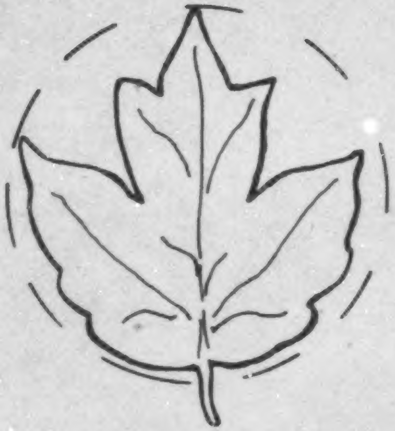
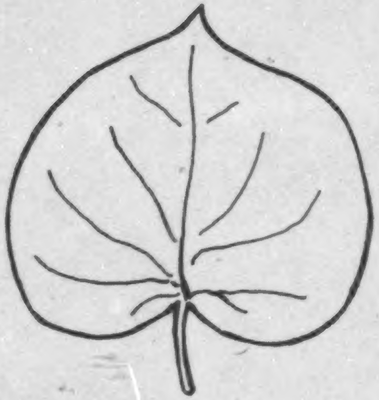

Cuneate

Leaf Shapes

(Continued)



Orbicular



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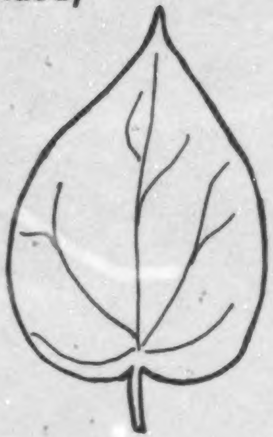
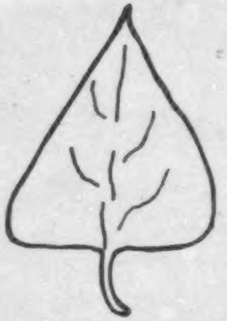


Cordate



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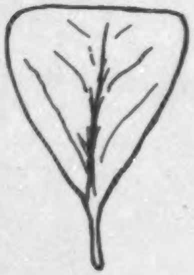
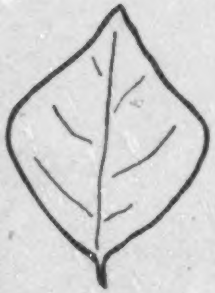
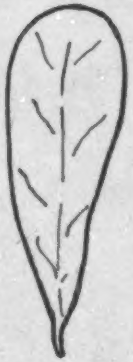


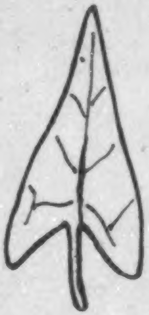
Obdeltoid



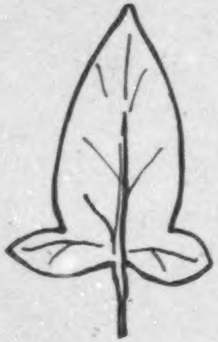
Rhomboid



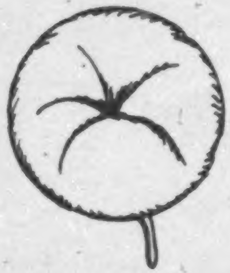
Spatulate



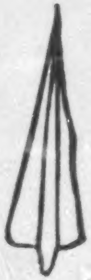
Sagittate



Hastate

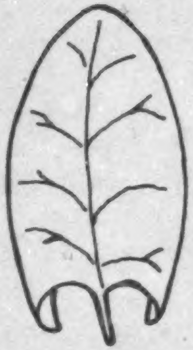


Peltate



Subulate

Leaf Margins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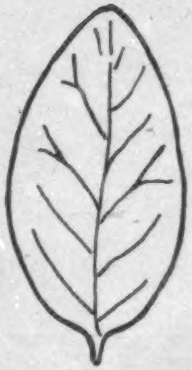
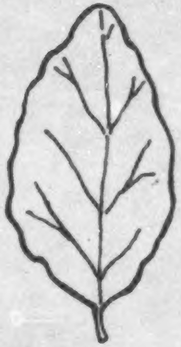
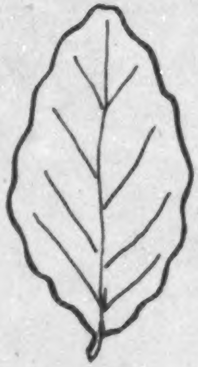
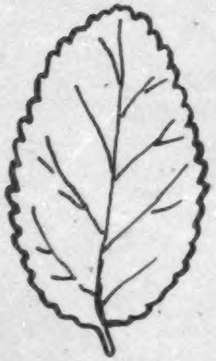
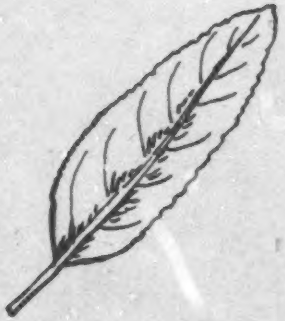
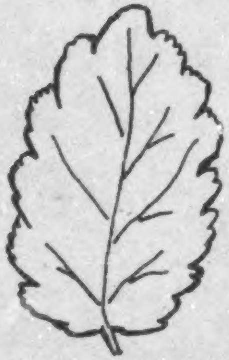

Entire

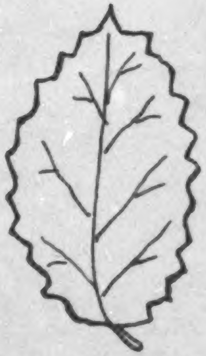

Repand

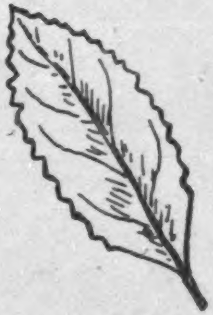

Sinuate


Crenate


Crenulate

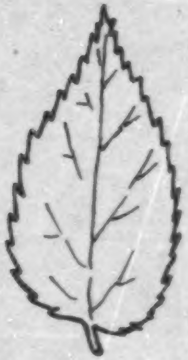

Doubly Crenate

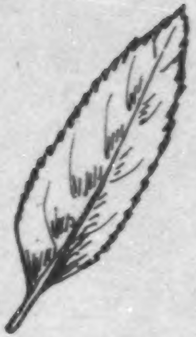

Dentate

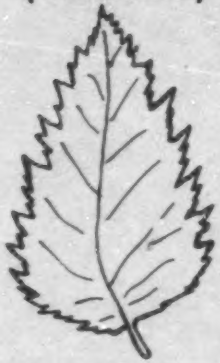

Denticulate

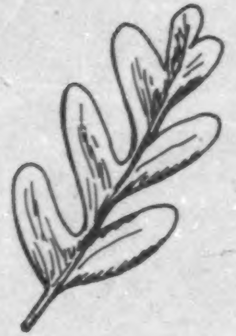
Leaf Margins

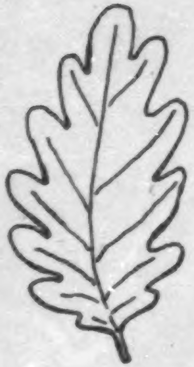
(Continued)

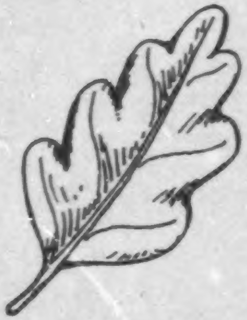

Serrate

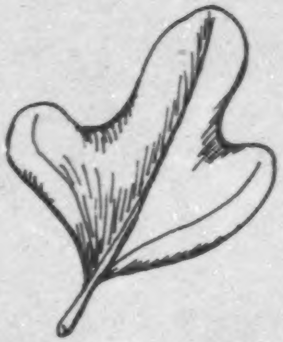

Serrulate

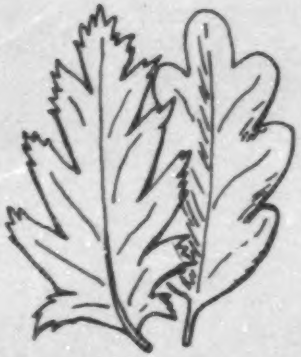

Doubly Serrate

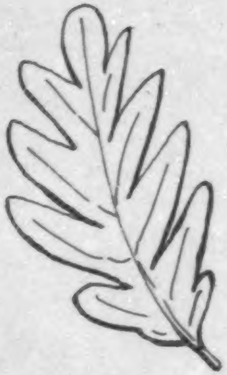

Divided


Lobed

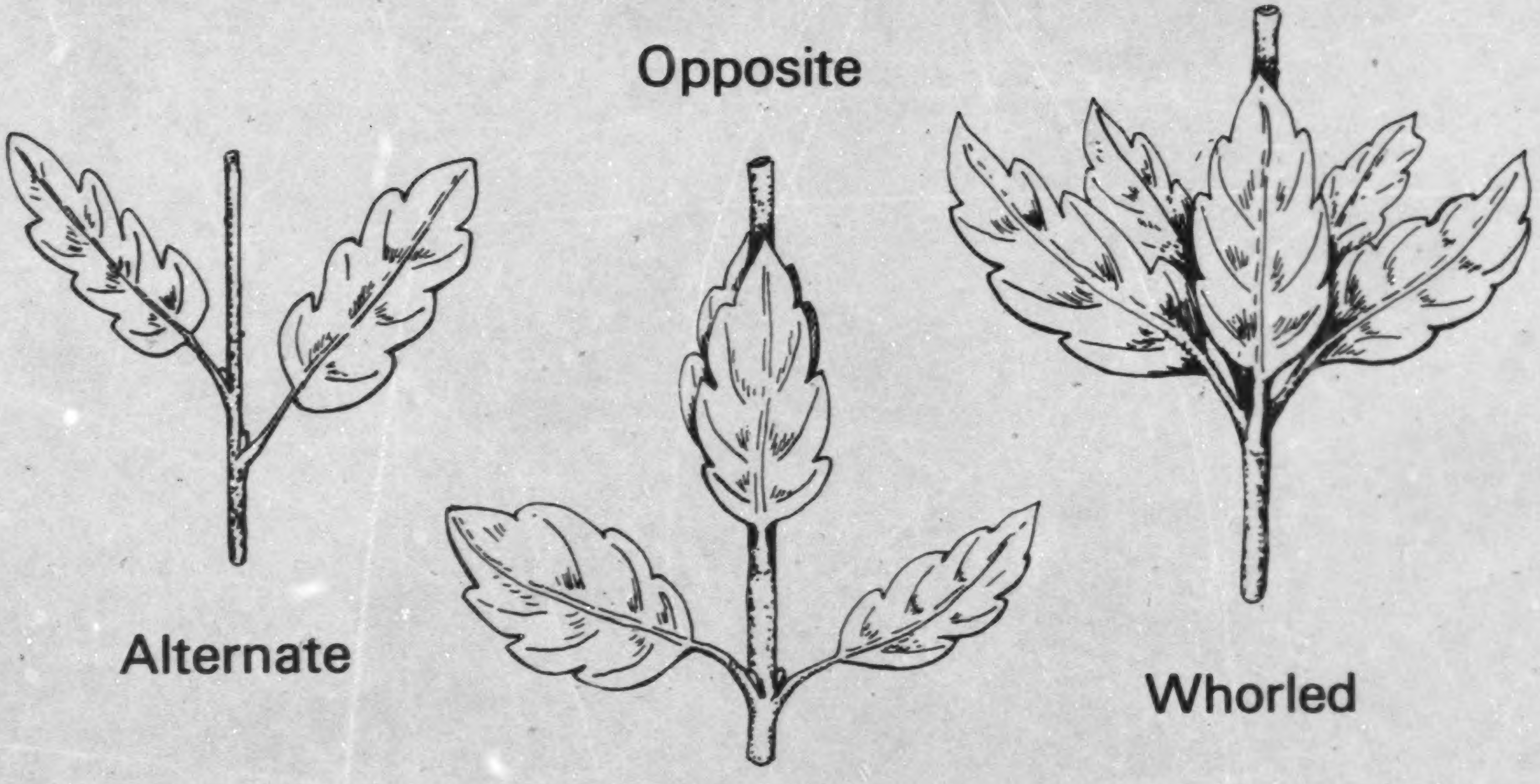

Pinnately Lobed


Palmately Lobed


Cleft


Parted

Leaf Arrangements


Opposite
Alternate
Whorled

IDENTIFYING OKLAHOMA TREES
UNIT I

ASSIGNMENT SHEET #1–IDENTIFY LEAF SHAPES AND LEAF MARGINS

1. Collect leaves from trees the instructor will point out by name. Place the leaves in a fold of newspaper with the name of the tree written on the newspaper.

2. Later place the newspaper with leaves in a warm location with a weight to press out and dry the leaves. The leaves can be left in newspaper, placed in file folders, or glued on cardboard. The leaves serve as a reference for identifying the trees.

3. Identify the collected leaves by filling in the chart on the following page using the terms provided. When finished turn in to the instructor for evaluation.

ASSIGNMENT SHEET #1

Leaf Shapes

- Acicular
- Scalelike
- Linear
- Oblong
- Lanceolate
- Oblanceolate
- Ovate
- Obovate
- Elliptical
- Oval
- Orbicular
- Reniform
- Cordate
- Obcordate
- Cuneate
- Deltoid
- Obdeltoid
- Rhomboid
- Spatulate
- Sagittate
- Hastate
- Peltate
- Subulate

Leaf Margins

- Revolute
- Entire
- Repand
- Sinuate
- Crenate
- Crenulate
- Doubly crenate
- Dentate
- Denticulate
- Serrate
- Serrulate
- Doubly serrate
- Divided
- Lobed
- Pinnately lobed
- Palmately lobed
- Cleft
- Parted

	Tree Name	Leaf Shape	Leaf Margin
(1)			
(2)			
(3)			
(4)			
(5)			
(6)			
(7)			
(8)			
(9)			
(10)			
(11)			
(12)			
(13)			
(14)			
(15)			
(16)			
(17)			
(18)			
(19)			
(20)			

IDENTIFYING OKLAHOMA TREES
UNIT I

ASSIGNMENT SHEET #2--IDENTIFY LEAF ARRANGEMENTS AND TREE SPECIES USING A KEY

For each tree the instructor points out, identify the species by name using the key provided in IX of information sheet. Identify the kind of leaf arrangement for each. When completed, turn in to the instructor for evaluation.

IDENTIFYING OKLAHOMA TREES
UNIT I

TEST

1. Match the terms on the right to the correct definition.

_____a. The seed bearing product of a plant

_____b. Plant bearing naked seeds

_____c. Always green; year-round

_____d. Minute opening in wood filled with resin

_____e. A fruit formed of overlapping scales

_____f. Plant bearing enclosed seeds

_____g. Leaves fall each autumn

_____h. A cell opening in angiosperms; occasionally visible to the naked eye

_____i. Refers to compound leaves

_____j. One blade

_____k. Several leaflets to form a leaf

_____l. A system of grouping species to be readily identified using leaves and other characteristics

_____m. The location of leaves on a stem

_____n. The separation between lobes

_____o. Branching by forking in pairs

_____p. The point on a stem where a leaf is found

1. Resin duct
2. Leaf composition
3. Sinus
4. Evergreen
5. Pore
6. Dichotomus
7. Fruit
8. Simple leaf
9. Angiosperm
10. Gymnosperm
11. Leaf arrangement
12. Key
13. Cone
14. Compound leaf
15. Deciduous
16. Node

2. Distinguish between the characteristics for each, gymnosperms and angiosperms, by placing a "G" or an "A" accordingly.

______a. Leaves needlelike, scalelike, or awl-like

______b. Called broadleaf or hardwoods

______c. Generally deciduous

______d. Called conifers or softwoods

______e. Fruit is dry or fleshy and encloses seed

______f. Fruit is a woody or fleshy cone

______g. Leaves are broadened; expanded blades

______h. Generally evergreen

______i. Wood has pores and no resin ducts

______j. Wood has no pores, but resin ducts sometimes do

3. Label this drawing of a simple leaf with the terms provided below.

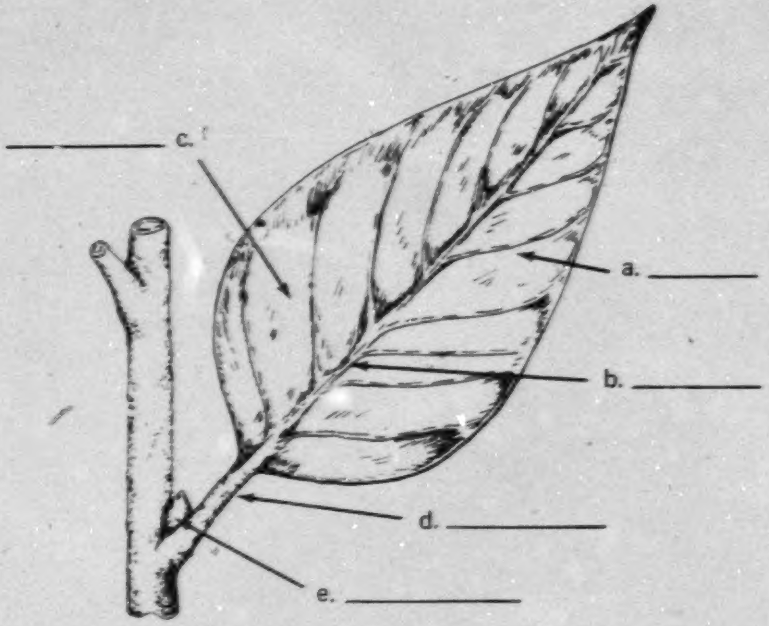
Vein

Midrib

Blade

Petiole

Bud



4. Name the four types of veins found in tree leaves.

   a.

   b.

   c.

   d.

5. Match the compound leaf terms on the right to the correct definitions.

______a. Three leaflets

______b. Three leaflets from the same point on the petiole

______c. Has a terminal leaflet

______d. Third division of leaflets

______e. All leaflets from the same point on the petiole

______f. Even number of leaflets

______g. Second division of leaflets

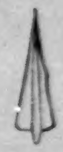
1. Odd-pinnate
2. Even-pinnate
3. Pinnately trifoliate
4. Palmate
5. Palmately trifoliate
6. Bipinnate
7. Tripinnate

6. Label the leaf shapes with the correct terms from the list given below.

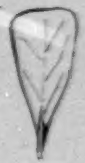
Acicular
Scalelike
Linear
Oblong
Lanceolate
Oblanceolate
Ovate
Obovate

Elliptical
Oval
Orbicular
Reniform
Cordate
Obcordate
Cuneate
Deltoid

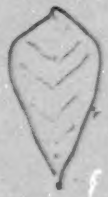
Obdeltoid
Rhomboid
Spatulate
Sagittate
Hastate
Peltate
Subulate



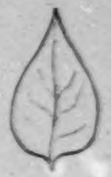
a.______________



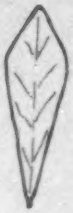
b.______________



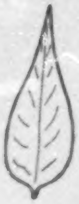
c.______________



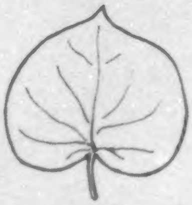
d.______________



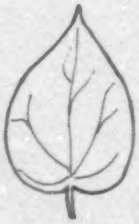
e. ____________



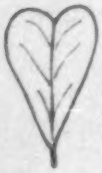
f. ____________



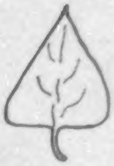
g. ____________



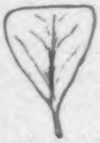
h. ____________



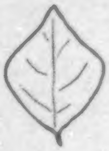
i. ____________



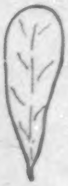
j. ____________



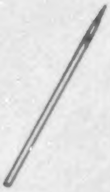
k. ____________



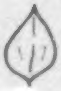
l. ____________



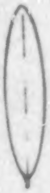
m. ____________



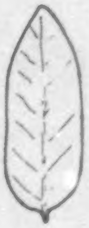
n. ____________



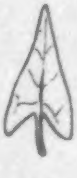
o. ____________



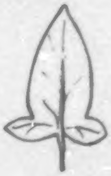
p. ____________



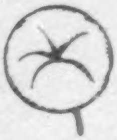
q. ____________



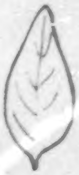
r. ____________



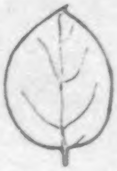
s. ____________



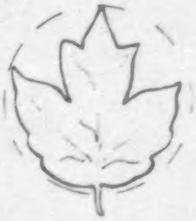
t. ____________



u. ____________



v. ____________



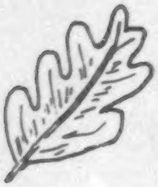
w. ____________

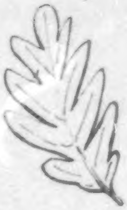
7. Label the leaf margins with the correct term from the list given below.

Revolute
Entire
Repand
Sinuate
Crenate
Crenulate

Doubly crenate
Dentate
Denticulate
Serrate
Serrulate
Doubly serrate

Divided
Lobed
Pinnately lobed
Palmately lobed
Cleft (used twice)
Parted


a.______________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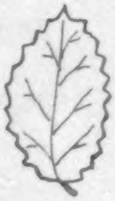
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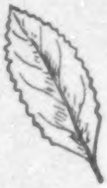
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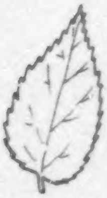
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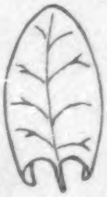
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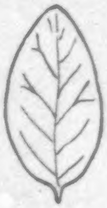
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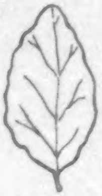
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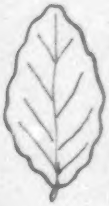
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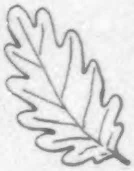
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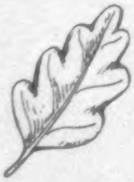
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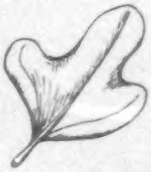
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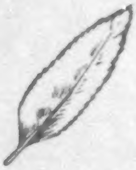
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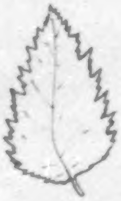
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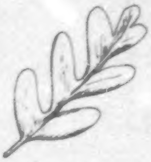
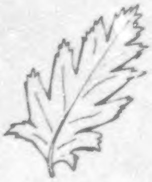
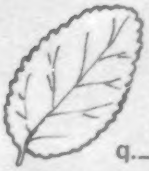
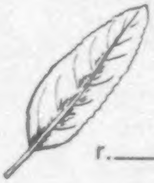
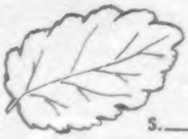

o.______________


p.______________

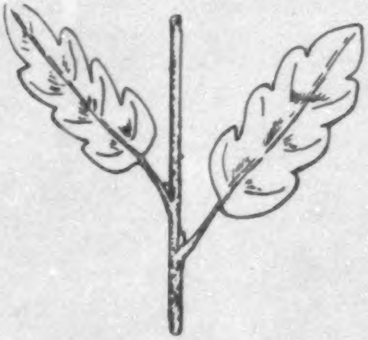

q.______________


r.______________

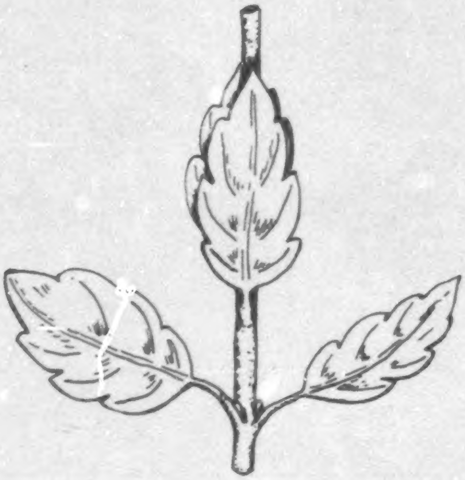

s.______________

8. Identify the following leaf arrangement by placing the correct number in the blanks provided.

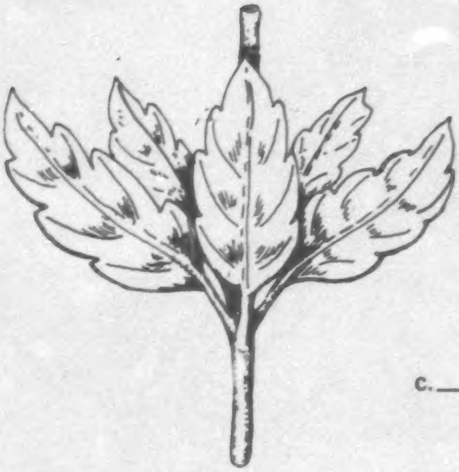
1. Opposite
2. Whorled
3. Alternate



a. ______________________________



b. ______________________________



c. ______________________________

9. Demonstrate the ability to identify trees using a key.

(NOTE: If this has not been accomplished prior to the test, ask the instructor when the above activity should be completed.)

IDENTIFYING OKLAHOMA TREES
UNIT I

ANSWERS TO TEST

1. a. 7
b. 10
c. 4
d. 1
e. 13
f. 9
g. 15
h. 5
i. 2
j. 8
k. 14
l. 12
m. 11
n. 3
o. 6
p. 16

2. a. G
b. A
c. A
d. G
e. A
f. G
g. A
h. G
i. A
j. G

3. a. Vein
b. Midrib
c. Blade
d. Petiole
e. Bud

4. a. Pinnate
b. Palmate
c. Closed
d. Arcuate

5. a. 3
b. 5
c. 1
d. 7
e. 4
f. 2
g. 6

6. a. Subulate
    b. Cuneate
    c. Obovate
    d. Ovate
    e. Oblanceolate
    f. Lanceolate
    g. Reniform
    h. Cordate
    i. Obcordate
    j. Deltoid
    k. Obdeltoid
    l. Rhomboid
    m. Spatulate
    n. Acicular
    o. Scalelike
    p. Linear
    q. Oblong
    r. Sagittate
    s. Hastate
    t. Peltate
    u. Elliptical
    v. Oval
    w. Orbicular

7. a. Cleft
    b. Parted
    c. Dentate
    d. Denticulate
    e. Serrate
    f. Revolute
    g. Entire
    h. Repand
    i. Sinuate
    j. Lobed
    k. Pinnately lobed
    l. Palmately lobed
    m. Serrulate
    n. Doubly serrate
    o. Divided
    p. Cleft
    q. Crenate
    r. Crenulate
    s. Doubly crenate

8. a. 3
    b. 1
    c. 2

9. Evaluated to the satisfaction of the instructor.

USING MEASUREMENT UNITS TO SOLVE FORESTRY PROBLEMS
UNIT II

TERMINAL OBJECTIVE

After completion of this unit, the student should be able to use measurement units of length, area, volume, and capacity and conversion factors of these to solve forestry problems. The student should also be able to obtain the correct answers when given essential measurements needed to solve the problems. This knowledge will be evidenced through demonstration and by scoring eighty-five percent on the unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms associated with measurement units to solve forestry problems to the correct definition.
2. Select conversion factors for length to obtain a correct answer when given a problem and a list of conversion factors or a map scale.
3. Determine area from conversion factors and from formulas for specific plane figures.
4. Solve for the unknown side of a right triangle.
5. Determine the area of triangles.
6. Determine the area of a circle when given one known measurement.
7. Determine the volume and capacity of various shaped solids using volume units.
8. Solve for the volume of various shaped solids and containers using formulas when given the essential measurements.
9. Solve for the weight of various shaped solids when given the essential measurements to obtain volume and the weight per unit of volume.

USING MEASUREMENT UNITS TO SOLVE FORESTRY PROBLEMS
UNIT II

SUGGESTED ACTIVITIES

I. Instructor:

  A. Provide students with objective sheet.

  B. Provide students with information and assignment sheets.

  C. Make transparencies.

  D. Discuss terminal and specific objectives.

  E. Discuss information and assignment sheets.

  F. Give test.

II. Students:

  A. Read objectives.

  B. Study information sheet.

  C. Complete assignment sheets.

  D. Take test.

INSTRUCTIONAL MATERIALS

I. Included in this unit:

  A. Objectives

  B. Information sheet

  C. Transparency masters

    1. TM 1--Area by Shape

    2. TM 2--Right Triangle

    3. TM 3--The Circle

    4. TM 4--Volume of Solids

D. Assignment sheets

  1. Assignment Sheet #1--Solve Forestry Problems Using Measurement Units of Length and Area

  2. Assignment Sheet #2--Solve Forestry Problems Using Measurement Units of Volume and Weight

E. Answers to assignment sheets

F. Test

G. Answers to test

II. References:

A. Forbes, Reginald D. *Forestry Handbook.* New York: The Ronald Press Co.

B. Carpenter, Edward C. and Floyd L. Otter. *Mathematics For Natural Resource Technicians.* Reedley, California: Vocational-Technical Division of Reedley College.

USING MEASUREMENT UNITS TO SOLVE FORESTRY PROBLEMS
UNIT II

INFORMATION SHEET

I. Terms and definitions

A. Area--The total outside surface usually expressed in square units

B. Conversion factor--A number used to change one unit to another

Example: 12 inches=1 foot; the conversion factor is 12

C. Ratio--The comparison of true quantities by division

D. Proportion--A statement that one ratio is equivalent to another

E. Square--A plane figure with four equal sides and four right angles

F. Rectangle--Any four-sided figure with four right angles

G. Parallelogram--A four-sided figure having opposite sides parallel and equal

H. Right triangle--A triangle that has one right angle and the other two of less than 90 degrees

I. Right angle--One-fourth of a circle or 90 degrees

J. Hypotenuse--The triangle side opposite the right angle

K. Circle--Closed curve upon which every point is equidistant from a fixed point called the center

L. Radius--A line drawn from the center of the circle to the exterior

M. Diameter--Any straight line from one point to another on the circle which goes through the center

N. Circumference--The line around a circle

O. Pi (π)--Symbol designating the ratio of the circumference of a circle to its diameter; π=3.14159365+, usually expressed as 3.14

P. Cubic--Product obtained by multiplying a given number or quantity by its square; three dimensions

Q. Cylinder--Parallel circles for the ends and parallel sides

R. Formula--A conventional method for doing something

INFORMATION SHEET

S. Cone--Has a circle for a base and tapers to a point

T. Pyramid--A polygonal base and sides of triangles that meet at a common point

II. Measurement units for length

A. Conversion factors for the surveyor's chain

TABLES

TABLE 1. – Length; unit conversion, factors, with approximate values

Inches	Links	Feet	Yards	Rods	Chains[1]	Miles[2]	Centimeters	Meters	Kilometers
[3]1	0.126263 (1/8)	0.083333 (1/12)	0.027778 (1/36)	0.00505 (1/200)	------	------	2.540005 (2 1/2)	0.0254 (1/40)	------
7.92	1	0.66 (2/3)	0.22	0.04 (1/25)	0.01 (1/100)	------	20.11684 (20)	0.201168 (1/5)	------
12	1.515152 (1 1/2)	[3]1	0.333333 (1/3)	0.060606 (1/16)	0.015152 (1/66)	0.000189	30.48006 (30)	0.304801 (3/10)	0.000305
36	4.545455 (4 1/2)	3	[3]1	0.181818 (1/5)	0.045455 (1/22)	0.000568	91.44018	0.914402 (9/10)	0.000914
0.3937 (2/5)	0.04971 (1/20)	0.032808 (1/30)	0.010936 (1/90)	------	------	------	[4]1	0.01	------
39.37 (40)	4.97096 (5)	3.280833	1.09361	0.198838 (1/5)	0.04971 (1/20)	0.000621 (1/1600)	100	1	0.001
							Furlongs		
198	25	16.5	5.5	1	0.25 (1/4)	0.003125 (1/320)	0.025 (1/40)	5.02921 (5)	0.005029 (1/200)
792	100	66	22	4	1	0.0125 (1/80)	0.1	20.1168 (20)	0.020117 (1/50)
	------	5,280	1,760	320	80	1	8	1,609.347 (1,600)	1.609347 (1 3/5)
	------	660	220	40	10	0.125 (1/8)	1	201.168	0.201168 (1/5)
	------	3,280.83	1,093.61	198.838 (200)	49.7096 (50)	0.62137 (5/8)	4.97096 (5)	1,000	1

[1] Surveyor's chain; the engineer's chain = 100 links of 1 foot each is not used.

[2] 1 nautical mile (termed "knot" as unit of velocity) = 1.1516 statute miles = 1.85325 km = 1 minute of arc on the earth's surface at the Equator.

[3] British units: 1 yard = 0.914399 m; 1 foot = 30.47997 cm; 1 inch = 2539998 cm; 1 hand = 4 inches = 10.16 cm; 1 span = 9 inches = 22.86 cm; 1 cubit = 18 inches = 45.72 cm.

[4] 1 millimeter = 0.1 cm = 0.03937 inch = 0.00328 foot.

SOURCE: U.S. DEPT. OF AGRICULTURE

(NOTE: Since there are always more units in the smaller denomination than in the larger, you multiply if your answer is to be in the smaller denomination, and you divide if it is to be in the larger.)

INFORMATION SHEET

B. Scales of maps and drawings as conversion factors

1. Arithmetic terms

   Example: 1"-1 mile and 1:24,000

2. Ratio and proportion

   Example: Given a scale of 1:62500 to find the land distance from A to B on a map where the map distance is 4 1/2 inches. Therefore, $\frac{x}{4.5} = \frac{62500}{1}$ and X=4.5 x 62500 X=281,250 inches, which divided by 5280=53.26 miles

III. Measurement units for area

A. Conversion factors for area

FACTORS AND TABLES OF EQUIVALENTS USED IN FORESTRY

TABLE 2. – Area or surface; unit conversion factors, with approximate values

Square inches	Square links	Square feet	Square yards	Square chains	Acres	Square centi-meters	Square meters	Hectares	Square kilo-meters
1	0.015942 (1/63)	0.006944	———	———	———	6.451626 (6 1/2)	0.000645	———	———
62.7264 (63)	1	0.4356 (3/7)	———	0.0001	0.00001	404.6873	0.040469 (1/25)	———	———
144	2.295684	1	0.111111 (1/9)	0.00023	0.000023	929.034	0.092903 (1/11)	———	———
1,296	20.6612 (20)	9	1	0.002066 (1/500)	0.000207	8,361.31	0.836131 (4/5)	———	———
0.155 (1/7)	———	0.001076 (1/1000)	———	———	———	[1]1	0.0001	———	———
1,549.997	24.7104	10.76387 (11)	1.19599 (1 1/5)	0.002471 (1/400)	0.000247	10,000	1	0.0001	———
						Square miles			
	10,000	4,356	484	[2]1	0.1	0.000156 (1/6400)	404.687	0.040469 (1/25)	0.000405 (1/2500)
		43,560	4,840	10	[3]1	0.0015625 (1/540)	4,046.87 (4,000)	0.404687 (2/5)	0.004047 (1/250)
		27,878,400	3,097,600	6,400	640	1	2,589,998	258.9098 (260)	2.589998 (2 3/5)
		107,638.7	11,959.9 (12,000)	24.7104 (25)	2.471044 (2 1/2)	0.003861 (1/250)	10,000	1	0.01
		10,763,867	1,195,985	2,471.04	247.104 (250)	0.386101 (2/5)	1,000,000	100	1

[1] 1mm 2 = 0.01 cm 2 = 0.00155 square inch.

[2] 1 square chain - 16 square rods.

[3] 1 acre = area 208.710 (210) feet square = 3.16 chains square.

MISC. PUBLICATION 225, U.S. DEPT. OF AGRICULTURE

(NOTE: Most units of area are squares of units of lengths. The notable exception is the acre which has no corresponding lineal unit.)

INFORMATION SHEET

B. Square areas--Side times side (Transparency 1)

C. Rectangles--Base times height

D. Parallelogram--Base times height

IV. Unknown side to the right triangle (Transparency 2)

A. Pythagoras Rule--"The square of the hypotenuse is equal to the sum of the squares of the other two sides."

$c= \sqrt{a^2+b^2}$; $a= \sqrt{c^2-b^2}$; $b= \sqrt{c^2-a^2}$

B. Finding the square root of a number

1. Estimate by bracketing--Try 12 and 13; since the square of 12 is 144 and 13^2=169, the square root of 150 (shown as 150) is between 12 and 13; use 12.3 as an estimate

2. Divide 150 by 12.3 = 12.2

3. Average of 12.3 and 12.2 = 12.25

4. Divide 150 by 12.25 = 12.244

5. Average of 12.25 and 12.244 = 12.247

6. Repeat until the average is as near as needed

V. Area of a triangle = 1/2 base times height (A=1/2bh) (Transparency 2)

VI. Area of a circle

A. Parts of a circle (Transparency 3)

1. Radius-point out 360°; $r= \frac{d}{2}$

2. Diameter-point out $d=2r$

3. Circumference-C = πd or $2\pi r$

B. Formula for the area of a circle--$A=\pi r^2$ or $\pi \frac{d^2}{4}$

VII. Determining volume and capacity from volume units

A. Volume--Linear units

1. 1728 cu. inches = 1 cu. ft.

2. 27 cu. ft. = 1 cu. yd.

INFORMATION SHEET

3. 35.3145 cu. ft. = 1.3079 cu. yd. = 1 cu. meter
4. 128 cu. ft. = 1 standard cord (4x4x8)

B. Volume–Capacity units

1. 231 cu. in. = 1 gallon
2. 4 quarts = 8 pints = 1 gallon
3. 7.48 gal. = 1 cu. ft.
4. 43,560 cu. ft. = 325,900 gal. = 1 acre-foot
5. 32 qt. = 1.244 cu. ft. = 1 bushel
6. 1.0567 qt. = 1 liter = 10,000 cu. centimeters

VIII. Formula for volume of various shaped solids and containers (Transparency 4)

A. Rectangular–V=lwh=length x width x height

B. Cylinder

1. $V = \pi r^2 h = Bh$, where B=area of base
2. $B = \pi r^2$ for square inches of area
3. $B = \frac{\pi d^2}{4(144)}$ or $.005454d^2$ for square feet of area

C. Cone--$V=1/3\, \pi r^2 h=1/3\ Bh$

IX. Measurement of weight

A. Units of weight

1. 16 ounces (oz.) = 1 pound (lb.)
2. 2000 lb. = 1 ton (T.)
3. 2.2t lb. = 1000 grams=1 kilogram

B. Weight measurement used with volume measurement--The General Sherman Sequoia tree has a circumference at the base of 102 ft., a base bark thickness of 2 ft., and a height of 272 ft. If we assume the trunk to be a true cone and use 40 lbs. as the weight per cu. ft., what would be the weight of the wood of this tree?

INFORMATION SHEET

1. Subtract the bark from the base to obtain a true wood measurement: 102 ft. ÷ 3.14=32.48

   32.48-4 ft = 28.48 ft. d

2. Vol. of a cone = 1/3 Bh

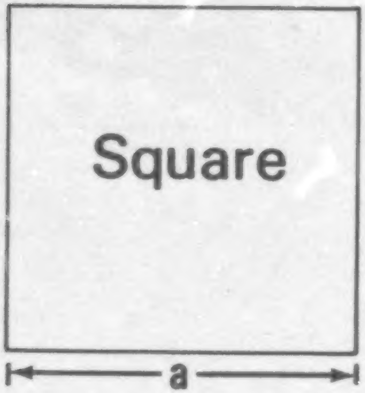
   a. Base = $\frac{\pi d^2}{4}$ = $\frac{(3.14)(811.11)}{4}$ = 638.72 sq. ft.

   b. Base times height=638.72 sq. ft. x 272 ft.=173,731.84 cu.

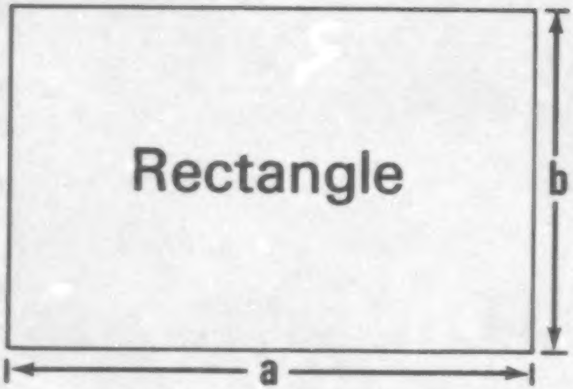
   c. 1/3 Bh= $\frac{173{,}731.84}{3}$ cu. ft. = 57,910.61 cu. ft.

   d. lbs. per cu. ft. x cu. ft. total = 40 x 57,910.61 = 2,316,424.40 lbs.

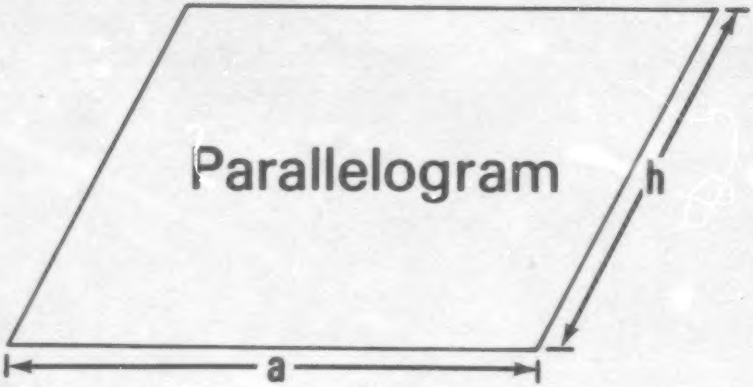
Area by Shape



A=area=a×a

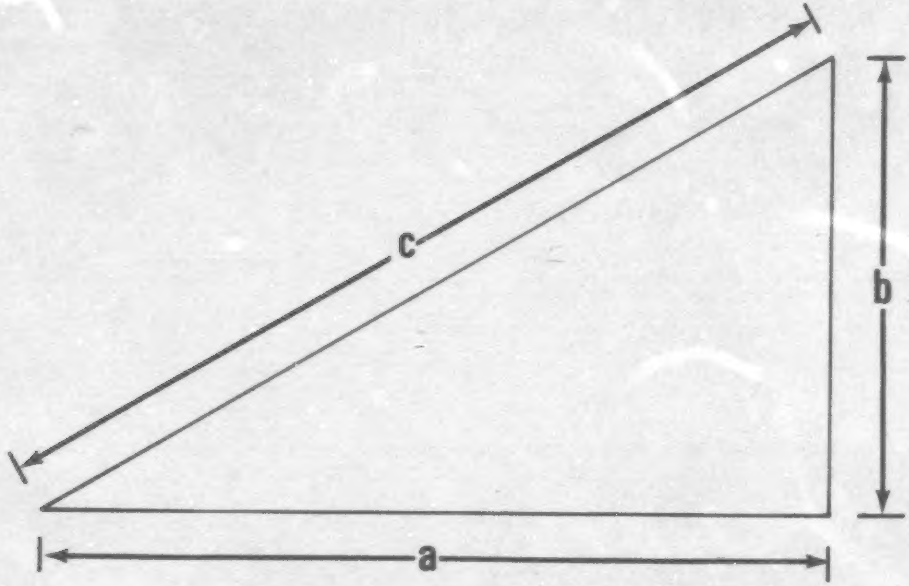

Rectangle
b
a

A=area=a×b


Parallelogram
h
a

A=area=a×h

Right Triangle



A = area = $1/2ab$

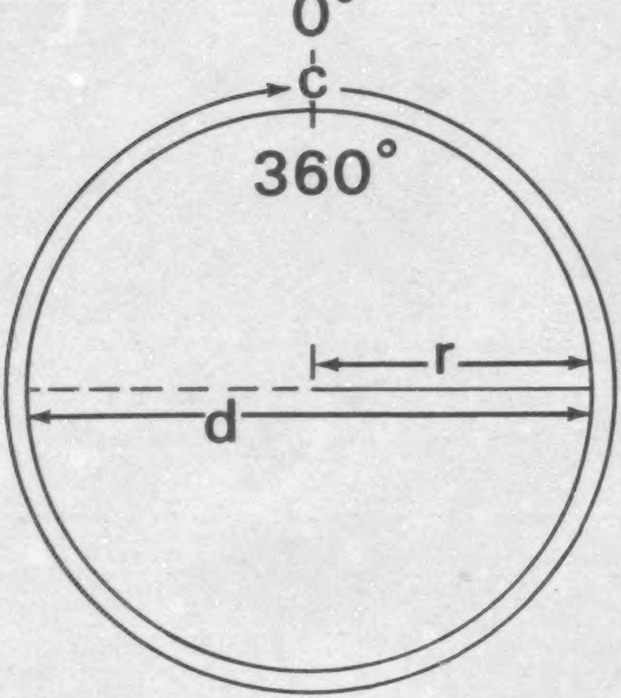
$c = \sqrt{a^2 + b^2}$

$a = \sqrt{c^2 - b^2}$

$b = \sqrt{c^2 - a^2}$

TM 2

The Circle



r = radius = $\frac{d}{2}$

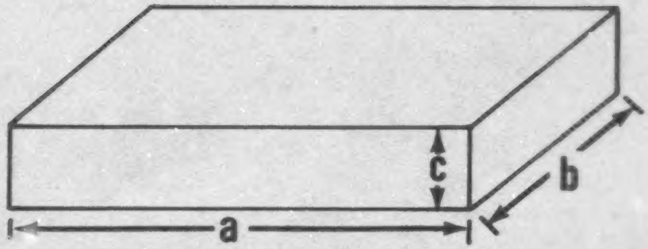
d = diameter = 2r

c = circumference = πd or $2 \pi r$

Area = πr^2 or $\frac{\pi d^2}{4}$

TM 3

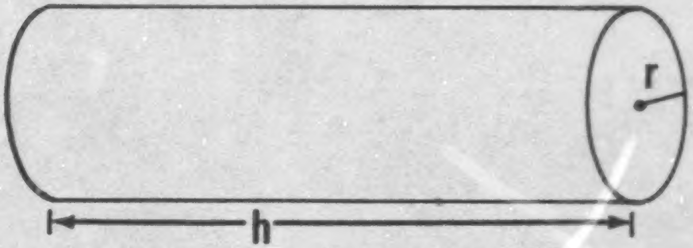
Volume of Solids



Rectangular

V = length×width×height

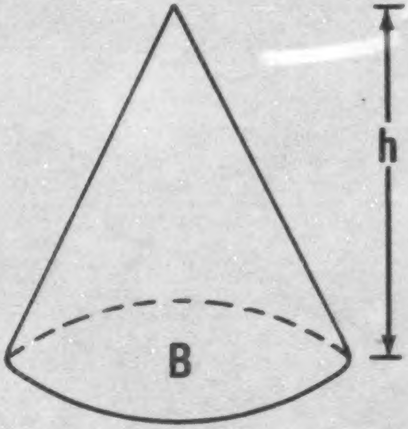
V = a×b×c



Cylinder

$V = \pi r^2 h$

$\pi = 3.14$



Cone

$V = 1/3 \pi r^2 h$

$\pi = 3.14$

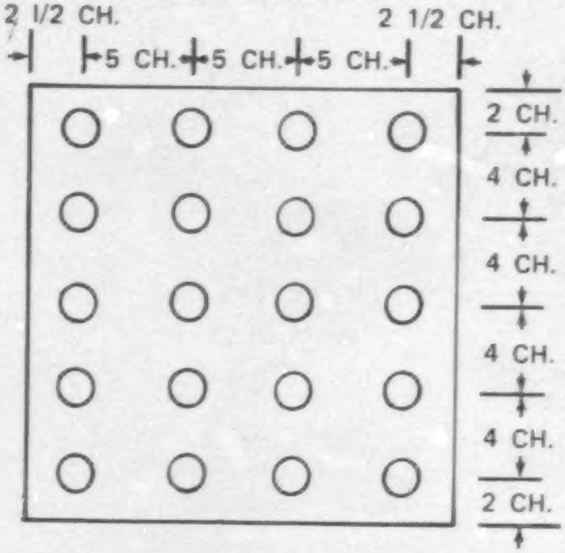
USING MEASUREMENT UNITS TO SOLVE FORESTRY PROBLEMS
UNIT II

ASSIGNMENT SHEET #1--SOLVE FORESTRY PROBLEMS USING MEASUREMENT UNITS OF LENGTH AND AREA

1. A rectangular parcel of land 136 by 200 ft. contains
how many square chains? a. ______________________________
how many acres? b. ______________________________

2. A rectangular piece of land 3.5 by 20 chains
contains how many square chains? a. _______________
how many acres? b. _______________

3. Timber cruising is sampling the forest for wanted information like board feet per acre of sawlog size trees. One way to sample is by plots as shown here:



a. What is the total tract acres in the above figure?__________ acres

b. If these are 1/5 acre plots, what is the total area measured? __________ acres

c. What proportion are these samples of the total tract acreage expressed as a ratio?__________

4. Many U. S. Geological Survey maps are drawn to the scale of 1:125,000.

Two inches on the map = __________ miles on the ground.

ASSIGNMENT SHEET #1

5. The circular plot is often used for taking samples of forest areas. A commonly used size has a radius of 52.7 feet.

   a. What is its diameter?________________

   b. What is its circumference?____________

   c. How many square feet does it have?____________

   d. What portion of an acre is this expressed as a fraction? ____________

6. On a square area of land that measures 80 chains on a side, find the distance between opposite corners which would form a triangle. ____________ chains.

USING MEASUREMENT UNITS TO SOLVE FORESTRY PROBLEMS
UNIT II

ASSIGNMENT SHEET #2–SOLVE FORESTRY PROBLEMS USING MEASUREMENT UNITS OF VOLUME AND WEIGHT

1. A cylindrical tank on a pumper truck used for fire fighting is 14 feet long and has a diameter of 6 feet.

   a. How many cubic feet does it have? ____________________

   b. How many gallons of water will it hold?____________________

2. A pile of chips used to make paper has accumulated in storage until it is 100 ft. in height and has a base diameter of 240 feet.

   a. How many cubic feet is in the pile? ____________________

   b. What does it weigh if a sample shows a cubic foot weighs 36 lbs.? ____________________

3. Fuel wood can be sold green or dry. A cord of oak weighs about 5700 lbs. green and 4100 lbs. dry. If you had a tag for 9 tons only:

   a. How many cords of green wood could you haul?____________________

   b. Dry wood?____________________

4. How many standard cords are on a railroad car stacked 8 feet wide, 28 feet long, and 7 feet high?

5. Road oil is mostly sold by the ton, but highway specifications call for the oil by the gallon. If 260 gallons of oil weigh a ton, how many feet of road can be oiled by a 4-ton load of oil spread at a rate of 1/2 gallon per lineal foot of road? ____________________feet

USING MEASUREMENT UNITS TO SOLVE FORESTRY PROBLEMS
UNIT II

ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheet #1

1. a. 6.244
   b. .62
2. a. 70
   b. 7
3. a. 40
   b. 4
   c. 10%, 1/10, 1:10
4. 3.94
5. a. 105.4'
   b. 330.96'
   c. 8720.69
   d. 1/5
6. 113.137 chains

Assignment Sheet #2

1. a. 395.64 cu. ft.
   b. 2,959.39 gallons
2. a. 2,260,800 cu. ft.
   b. 81,388,800 lbs.
3. a. 3.15
   b. 4.39
4. 12.25 cds.
5. 2080 feet

USING MEASUREMENT UNITS TO SOLVE FORESTRY PROBLEMS
UNIT II

TEST

1. Match the terms on the right to the correct definition.

_____a. The total outside surface usually expressed in square units

_____b. A number used to change one unit to another

_____c. The comparison of true quantities by division

_____d. A statement that one ratio is equivalent to another

_____e. A plane figure with four equal sides and four right angles

_____f. Any four-sided figure with four right angles

_____g. A four-sided figure having opposite sides parallel and equal

_____h. A triangle that has one right angle and the other two of less than 90 degrees

_____i. One-fourth of a circle or 90 degrees

_____j. The triangle side opposite the right angle

_____k. Closed curve upon which every point is equidistant from a fixed point called the center

_____l. A line drawn from the center of the circle to the exterior

_____m. Any straight line from one point to another on the circle which goes through the center

_____n. The line around a circle

1. Proportion
2. Right triangle
3. Circle
4. Circumference
5. Hypotenuse
6. Square
7. Diameter
8. Area
9. Cubic
10. Formula
11. Rectangle
12. Cone
13. Pi (π)
14. Ratio
15. Pyramid
16. Parallelogram
17. Conversion factor
18. Cylinder
19. Right angle
20. Radius

______o. Symbol designating the ratio of the circumference of a circle to its diameter; π =3.14159365+, usually expressed as 3.14

______p. Product obtained by multiplying a given number or quantity by its square; three dimensions

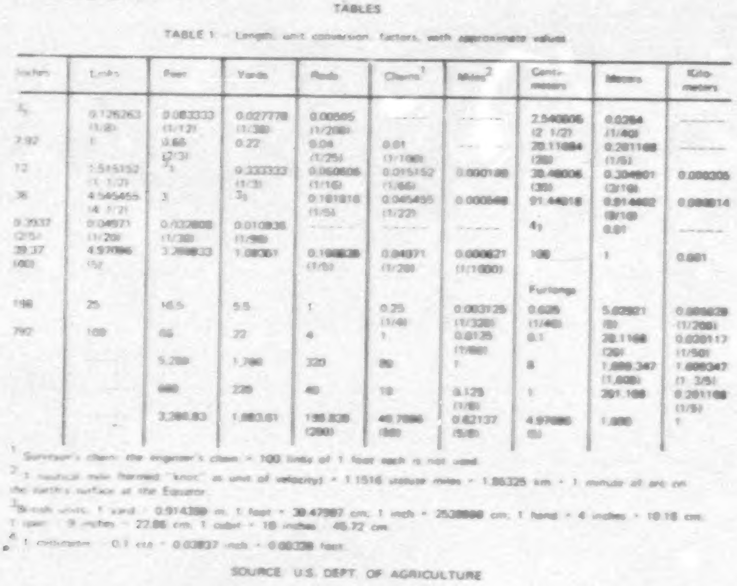
______q. Parallel circles for the ends and parallel sides

______r. A conventional method for doing something

______s. Has a circle for a base and tapers to a point

______t. A polygonal base and sides of triangles that meet at a common point

2. Select conversion factors from the given table to obtain a correct answer for the following problem:



TABLES

TABLE 1. – Length: unit conversion factors, with approximate values

Inches	Links	Feet	Yards	Rods	Chains[1]	Miles[2]	Centimeters	Meters	Kilometers
1[3]	0.126263 (1/8)	0.083333 (1/12)	0.027778 (1/36)	0.00505 (1/200)	------	------	2.540005 (2 1/2)	0.0254 (1/40)	------
7.92	1	0.66 (2/3)	0.22	0.04 (1/25)	0.01 (1/100)	------	20.11684 (20)	0.201168 (1/5)	------
12	1.515152 (1 1/2)	1[3]	0.333333 (1/3)	0.060606 (1/16)	0.015152 (1/66)	0.000189	30.48006 (30)	0.304801 (3/10)	0.000305
36	4.545455 (4 1/2)	3	1[3]	0.181818 (1/5)	0.045455 (1/22)	0.000568	91.44018	0.914402 (9/10)	0.000914
0.3937 (2/5)	0.04971 (1/20)	0.032808 (1/30)	0.010936 (1/90)	------	------	------	1[4]	0.01	------
39.37 (40)	4.97096 (5)	3.280833	1.09361	0.198838 (1/5)	0.04971 (1/20)	0.000621 (1/1600)	100	1	0.001
							Furlongs		
198	25	16.5	5.5	1	0.25 (1/4)	0.003125 (1/320)	0.025 (1/40)	5.02921 (5)	0.005029 (1/200)
792	100	66	22	4	1	0.0125 (1/80)	0.1	20.1168 (20)	0.020117 (1/50)
		5,280	1,760	320	80	1	8	1,609.347 (1,600)	1.609347 (1 3/5)
		660	220	40	10	0.125 (1/8)	1	201.168	0.201168 (1/5)
		3,280.83	1,093.61	198.838 (200)	49.7096 (50)	0.62137 (5/8)	4.97096 (5)	1,000	1

[1] Surveyor's chain; the engineer's chain = 100 links of 1 foot each is not used.

[2] 1 nautical mile (termed "knot" as unit of velocity) = 1.1516 statute miles = 1.85325 km = 1 minute of arc on the earth's surface at the Equator.

[3] British units: 1 yard = 0.914399 m; 1 foot = 30.47997 cm; 1 inch = 2.539998 cm; 1 hand = 4 inches = 10.16 cm; 1 span = 9 inches = 22.86 cm; 1 cubit = 18 inches = 45.72 cm.

[4] 1 millimeter = 0.1 cm = 0.03937 inch = 0.00328 foot.

SOURCE: U.S. DEPT. OF AGRICULTURE

To measure a township line which is about 6 miles long, how many chains would be measured? a.______________________chains

How many feet in length? b.______________________feet

How many rods or poles? c.______________________rods or poles

How many inches on a map with a scale of 1:21,000? d.______inches

3. Determine the area around a fire which is square in shape and 8800 yards in total distance around. Using the formula for a square and the given table of area conversion factors, determine:

FACTORS AND TABLES OF EQUIVALENTS USED IN FORESTRY

TABLE 2. – Area or surface; unit conversion factors, with approximate values

Square inches	Square links	Square feet	Square yards	Square chains	Acres	Square centimeters	Square meters	Hectares	Square kilometers
1	0.015942 (1/63)	0.006944	———	———	———	6.451626 (6 1/2)	0.000645	———	———
62.7264 (63)	1	0.4356 (3/7)	———	0.0001	0.00001	404.6873	0.040469 (1/25)	———	———
144	2.295684	1	0.111111 (1/9)	0.00023	0.000023	929.034	0.092903 (1/11)	———	———
1,296	20.6612 (20)	9	1	0.002066 (1/500)	0.000207	8,361.31	0.836131 (4/5)	———	———
0.155 (1/7)	———	0.001076 (1/1000)	———	———	———	[1] 1	0.0001	———	———
1,549.997	24.7104	10.76387 (11)	1.19599 (1 1/5)	0.002471 (1/400)	0.000247	10,000	1	0.0001	———
						Square miles			
	10,000	4,356	484	[2] 1	0.1	0.000156 (1/6400)	404.687	0.040469 (1/25)	0.000405 (1/2500)
		43,560	4,840	10	[3] 1	0.0015625 (1/640)	4,046.87 (4,000)	0.404687 (2/5)	0.004047 (1/250)
		27,878,400	3,097,600	6,400	640	1	2,589,998	258.9998 (260)	2.589998 (2 3/5)
		107,639.7	11,959.9 (12,000)	24.7104 (25)	2.471044 (2 1/2)	0.003861 (1/260)	10,000	1	0.01
		10,763,867	1,195,986	2,471.04	247.104 (250)	0.386101 (2/5)	1,000,000	100	1

[1] 1mm 2 = 0.01 cm 2 = 0.00155 square inch.

[2] 1 square chain - 16 square rods.

[3] 1 acre = area 208.710 (210) feet square = 3.16 chains square.

MISC. PUBLICATION 225, U.S. DEPT. OF AGRICULTURE

a. Number of acres____________________

b. Number of square chains ____________________

c. Number of square feet____________________

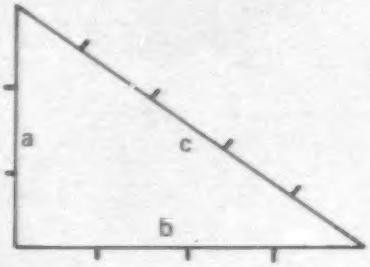
If the fire shape was a rectangle with a long side or base of 3300 yards, determine:

d. Number of acres________________

e. Number of square chains________________

f. Number of square feet________________

4. Using the following diagram as an aid, solve for the unknown side of the right triangles.



a. a=6" c=10" Find b_____

b. a=4" b=4" Find c_____

c. a=5" b=6" Find c_____

5. Determine the area of the triangles in problem 4.

a. Area________sq. in.

b. Area________sq. in.

c. Area________sq. in.

6. Determine the area of a circle plot that has a radius of 58.88 feet.

____

7. From this table of volume units, determine the number of gallons of chemical mix needed to fill a metal tank that has a capacity of 10 cubic yards.

231 cu. in. = 1 gal.

1728 cu. in. = 1 cu. ft.

27 cu. ft. = 1 cu. yd.

8. Solve for volume in the following problems using the correct formula from these listed:

$V=lwh$; $V=\pi r^2h$; $V=1/3\pi r^2h$

a. A round pond is 120 ft. across and slopes to a middle depth of 10 ft. What is the volume in cu. ft.?____________________

b. The volume capacity of a culvert has an inside diameter of 40" and is 20' long. What is the volume in cu. ft.?__________

9. If water weighs 8 lbs per gal. and there are 7.48 gals. in a cubic foot, how much weight would there be for a tank of water 10 feet by 8 feet by 20 feet long?____________________

USING MEASUREMENT UNITS TO SOLVE FORESTRY PROBLEMS
UNIT II

ANSWERS TO TEST

1. a. 8
   b. 17
   c. 14
   d. 1
   e. 6
   f. 11
   g. 16
   h. 2
   i. 19
   j. 5
   k. 3
   l. 20
   m. 7
   n. 4
   o. 13
   p. 9
   q. 18
   r. 10
   s. 12
   t. 15
2. a. 480 chains
   b. 31,680 feet
   c. 1,920 rods or poles
   d. 18 inches
3. a. 1,000
   b. 10,000
   c. 43,456,000
   d. 750
   e. 7,500
   f. 32,670,000
4. a. b=8"
   b. c=5.66"
   c. c=7.81"
5. 24 sq. in.
   8 sq. in.
   15 sq. in.

6. 10,885.92 (approximately 1/4 acre)
7. 2019.6 gals.
8. a. 37,680 cu. ft.
   b. 174.53 cu. ft.
9. 95,744 lbs.

FOREST SURVEYING
UNIT I

TERMINAL OBJECTIVE

After completion of this unit, the student should be able to use a compass to find bearings and azimuths. He should also be able to "pace" and to use an Abney hand level and steel tape in conjunction with the compass in forest surveying. This knowledge will be evidenced through demonstration and by scoring eighty-five percent on the unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms associated with forest surveying to the correct definition.
2. List two methods used to measure horizontal distances.
3. List the types of tapes used in forest surveying.
4. Arrange in order the steps followed in chaining horizontal distances.
5. Arrange in order the steps followed in chaining along slopes.
6. Tell how to measure around obstacles and inaccessible lines with a tape.
7. List the three essential parts and three accessories of a compass.
8. List the two directions obtained from a compass.
9. List three ways to find magnetic declination.
10. List the true azimuths and bearings when given the magnetic declination and magnetic angles.
11. List five guidelines to follow when reading a compass.
12. Demonstrate the ability to:
    a. Develop pacing skill.
    b. Measure horizontal distance along a slope.

FOREST SURVEYING
UNIT I

SUGGESTED ACTIVITIES

I. Instructor:

  A. Provide students with objective sheet.

  B. Provide students with information, assignment, and job sheets.

  C. Make transparencies.

  D. Discuss terminal and specific objectives.

  E. Discuss information and assignment sheets.

  F. Demonstrate and discuss procedures outlined in the job sheets.

  G. Arrange field trips to allow students an opportunity to demonstrate the procedures outlined in the job sheets.

  H. Give test.

II. Students:

  A. Read objectives.

  B. Study information sheet.

  C. Complete assignment sheet.

  D. Participate in field trip.

  E. Demonstrate the ability to accomplish the procedures outlined in the job sheets.

  F. Take test.

INSTRUCTIONAL MATERIALS

I. Included in this unit:

  A. Objectives

  B. Information sheet

C. Transparency masters

  1. TM 1--Chain Slopes

  2. TM 2--Lay Out Right Angles

  3. TM 3--Measure Inaccessible Lines

  4. TM 4--Azimuths and Bearings

  5. TM 5--Isogonic Chart

  6. TM 6--Angle Corrections

D. Assignment Sheet #1--Determine Azimuths and Bearings

E. Answers to assignment sheet

F. Job sheets

  1. Job Sheet #1--Develop Pacing Skill

  2. Job Sheet #2--Measure Horizontal Distance Along a Slope

G. Test

H. Answers to test

II. References:

A. Avery, T. Eugene. *Forest Measurements*. New York: The Ronald Press Co.

B. Forber, Reginald D. *Forestry Handbook*. New York: The Ronald Press Co.

FOREST SURVEYING
UNIT I

INFORMATION SHEET

I. Terms and definitions

A. Pacing--Determining a horizontal distance using a natural walking gait

(NOTE: Each step or every other step can be counted.)

B. Chaining--Measuring a horizontal distance with tape or chain

C. Chain--Gunters chain, the original tool for measuring distance in the woods, is 66 feet long and is composed of 100 links of stout wire, each 7.92 inches long

(NOTE: Distances on all U. S. Government Land Surveys are measured in chains and links. The simple conversion of chained dimensions to acres is a reason for the continued popularity of the chain. Ten square chains equal one acre. Chains are now marked on steel tapes.)

D. Tape--A narrow strip of steel marked off in graduations for measuring length

E. Pole--One-fourth of a chain or 16 1/2 feet in distance; originated from a chicken house perch pole from England

F. Slope tape--Topographic steel trailer tape for measuring horizontal distance on slopes

G. Abney hand level--An instrument that measures the angle between the horizontal plane and the line of sight along a slope

H. Breaking-the-chain--Measuring a distance of less than full chains due to an obstacle

I. Throwing-the-chain--A method of coiling the steel tape for storage and transport

J. Compass--An instrument used to find horizontal angles; gives direction

K. Azimuth--A horizontal angle measured clockwise from 0° to 360°

L. Bearing--A horizontal angle measured from north to south in an east or west direction up to 90°; compass face is divided into four quadrants

INFORMATION SHEET

M. Magnetic declination--The correction in horizontal angle needed to convert magnetic readings to true readings

N. Back sight--A horizontal angle read 180° from a corresponding foresight

II. Methods of measuring horizontal distances

A. Pacing

(NOTE: The precise pacer achieves an accuracy of 1 part in 80. Adjustment is necessary for obstacles and slopes.)

B. Chaining

III. Types of tapes

A. Surveyor's tape--Usually in 2 chains and graduated in links and poles (rods)

B. Slope tape--Same as surveyor's tape, but has a trailer graduated to adjust for horizontal measurement on slopes

C. Engineer's tape--Graduated into links of 1 foot each; comes in lengths of 100, 200, and 300 feet

IV. Steps in chaining horizontal distances

(NOTE: The steps are to be followed by a two-man crew.)

A. Head chainman pulls "O" end of chain

B. Head chainman kept in line by rear chainman with the use of a compass

C. Rear chainman calls "chain" as tape reaches the desired graduation of measurement

D. Head chainman pulls chain taut (20 lbs.) and if necessary aligns tape

E. Rear chainman yells "stick" when alignment is adequate

F. Head chainman plumb bobs the "O" mark or "eyeballs it" and marks with a chaining pin; then he yells "stuck"

V. Chaining slopes (Transparency 1)

A. Obtain Abney hand level readings along slope

B. Obtain trailer readings corresponding to the Abney readings

INFORMATION SHEET

C. Extend the tape the distance indicated on the trailer

(NOTE: The slope measurement is more than horizontal both up and down the slope.)

VI. Chaining procedures when obstacles are encountered

A. Lay out a right angle (Transparency 2)

1. Measure points A and B any distance

2. Measure distance clear of the obstacle used as an arc from A and B

B. Measure inaccessible lines (Transparency 3)

1. To measure V-W, set a point O any distance and equal distance in line to Y

2. Set U-X in line through O

3. Set Z in line with O-W

4. Measure Z-Y to equal the distance V-W

VII. Parts of a compass

A. Essentials

1. Magnetized needle

2. Pivot point

3. Graduated housing

B. Accessories

1. Magnetic declination adjustment

2. Leveling device

3. Sighting device

VIII. Directions of a compass (Transparency 4)

A. Azimuths

B. Bearings

INFORMATION SHEET

IX. Magnetic declination determination

- A. Isogonic charts (Transparency 5)
- B. Angle readings on Polaris (North Star)
- C. Reference survey line

X. Correcting magnetic azimuths and bearings to true readings (Transparency 6)

- A. Record true readings

  Example:

  For 8° East
  Magnetic Declination

	Mag. Reading		True Reading
Azimuth	24°	=	32°

- B. Adjust the compass
  - 1. Reset magnetic declination screw
  - 2. Read corrected magnetic angle

    Example:

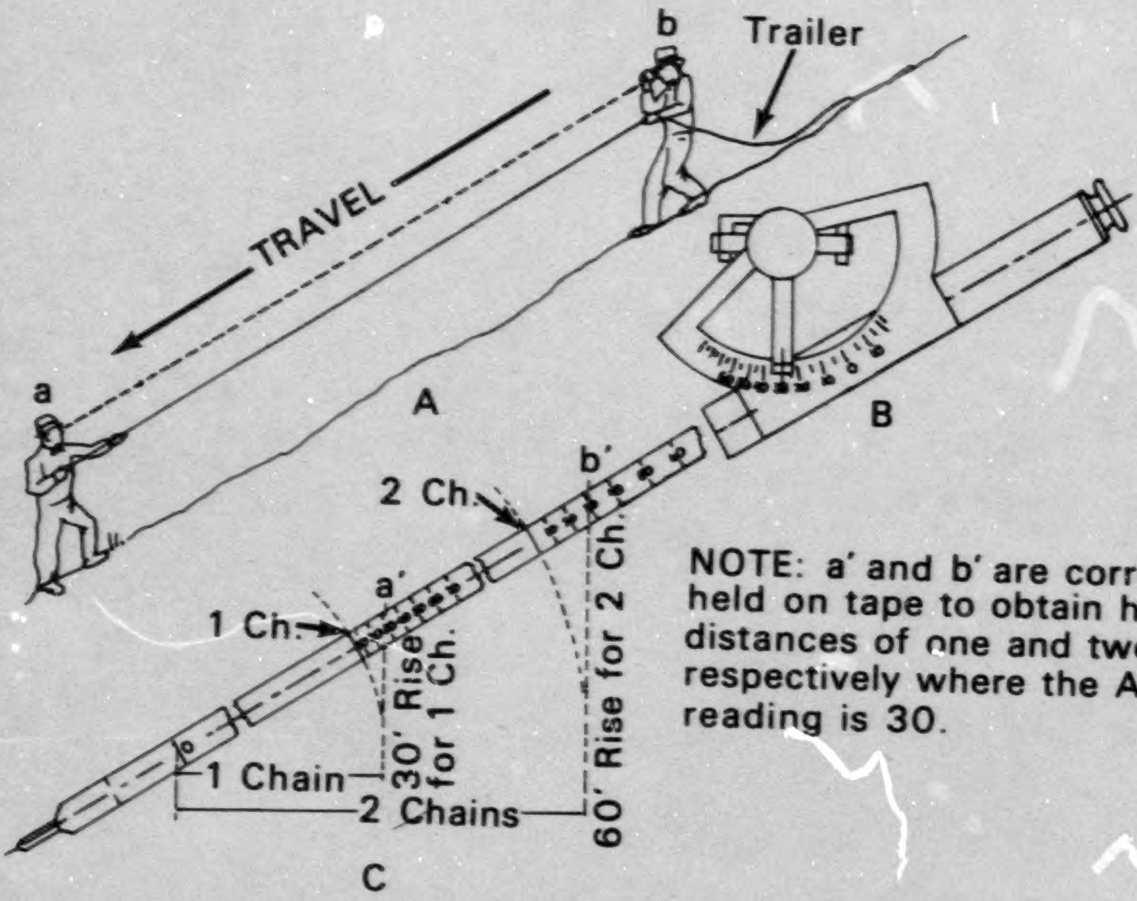
    For 8° East
    Magnetic Declination
    True direction from
    magnetic reading

	True Reading		Mag. Reading
Azimuth	140°	=	132°

XI. Guidelines to follow when reading the compass

- A. Level the compass
- B. Align sights properly
- C. Check to see that needle swings freely
- D. Read north end of needle
- E. Take back sight

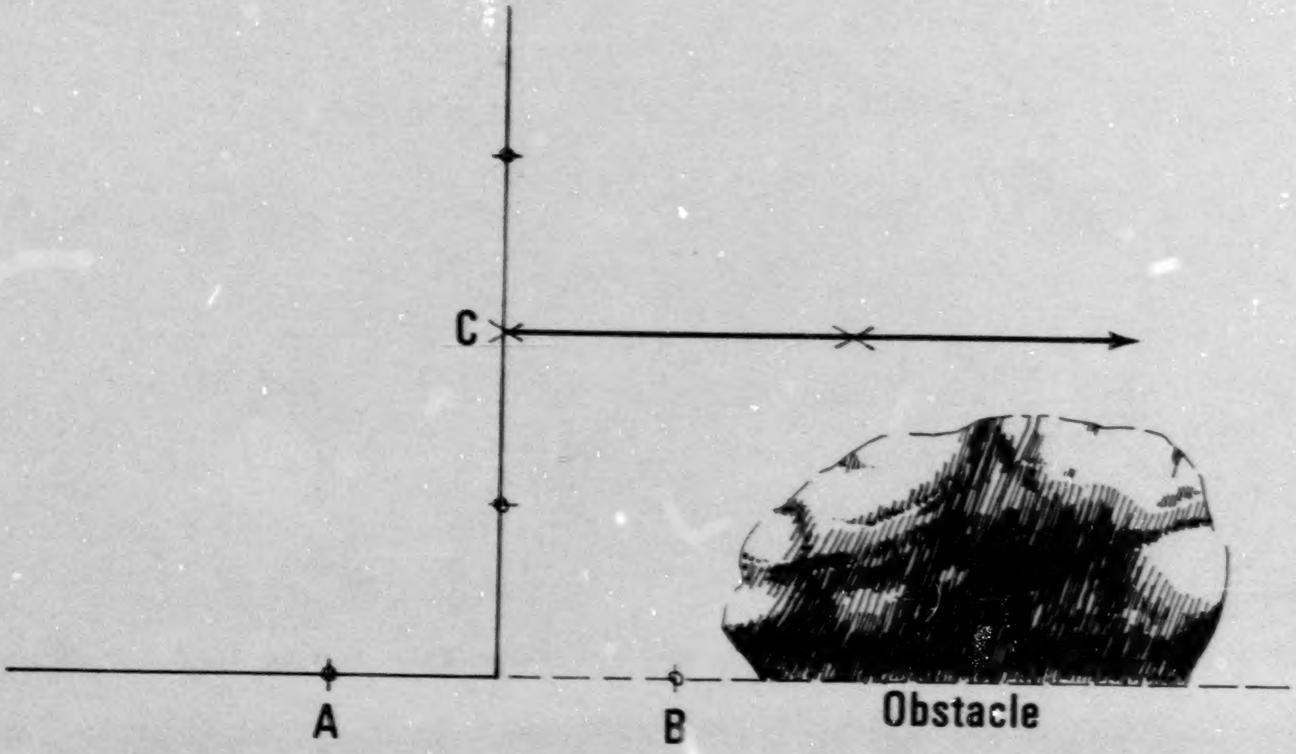
Chain Slopes


b
Trailer
TRAVEL
a
A
B
b′
2 Ch.
a′
1 Ch.
30′ Rise for 1 Ch.
60′ Rise for 2 Ch.
1 Chain
2 Chains
C

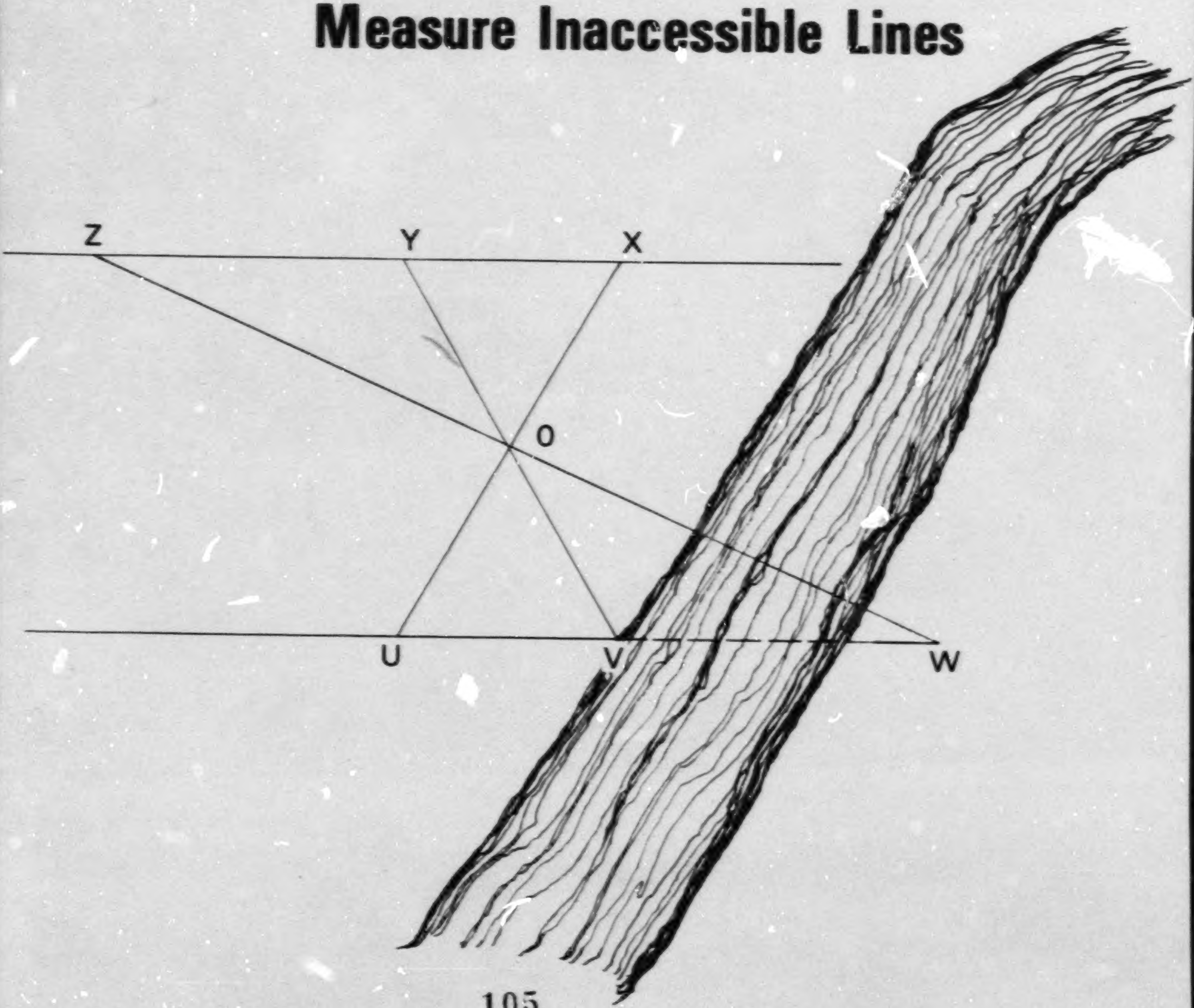
NOTE: a′ and b′ are correction marks held on tape to obtain horizontal distances of one and two chains respectively where the Abney reading is 30.

Topographic Abney In Use

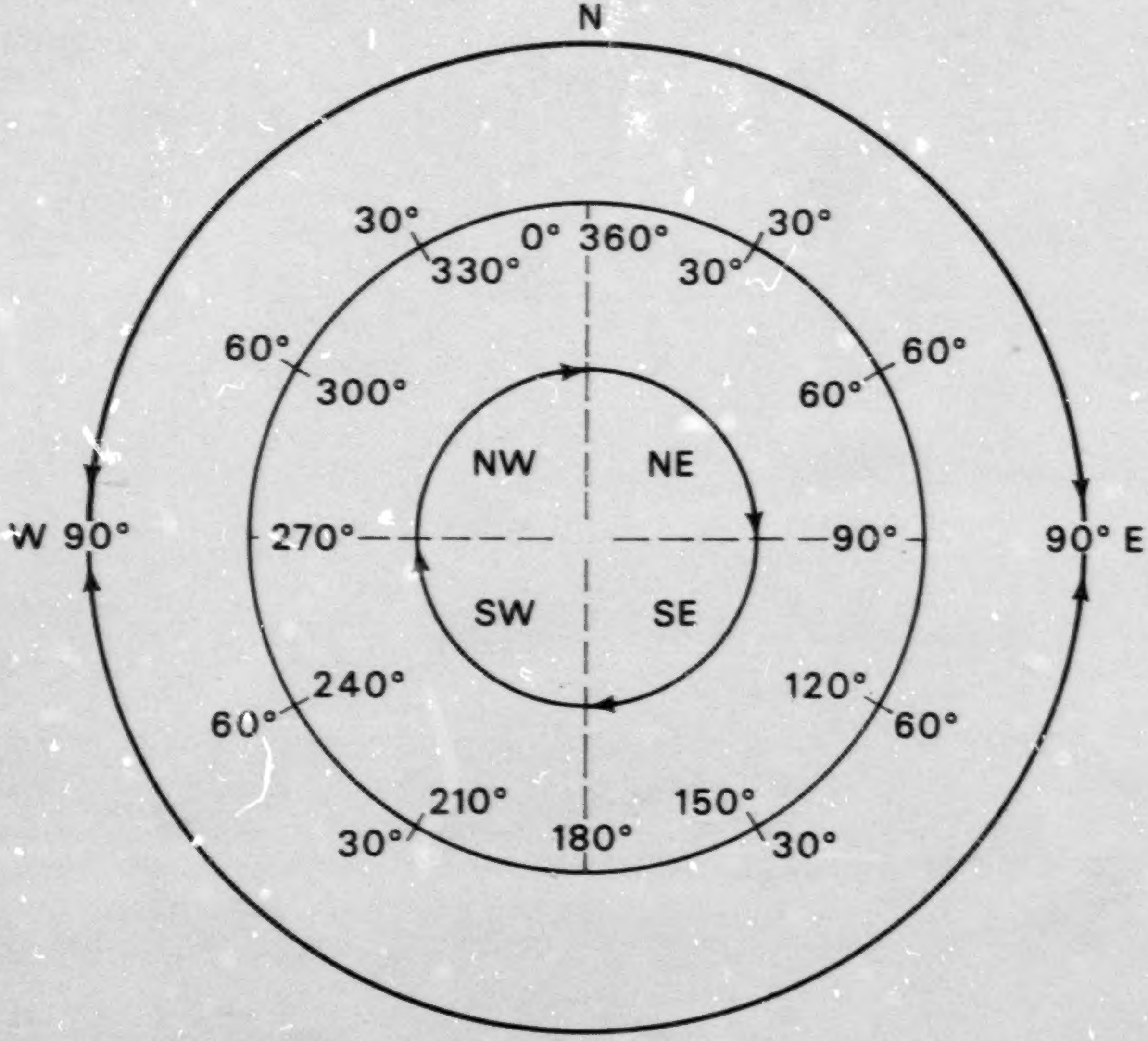
Lay Out Right Angles


C
A
B
Obstacle

Measure Inaccessible Lines

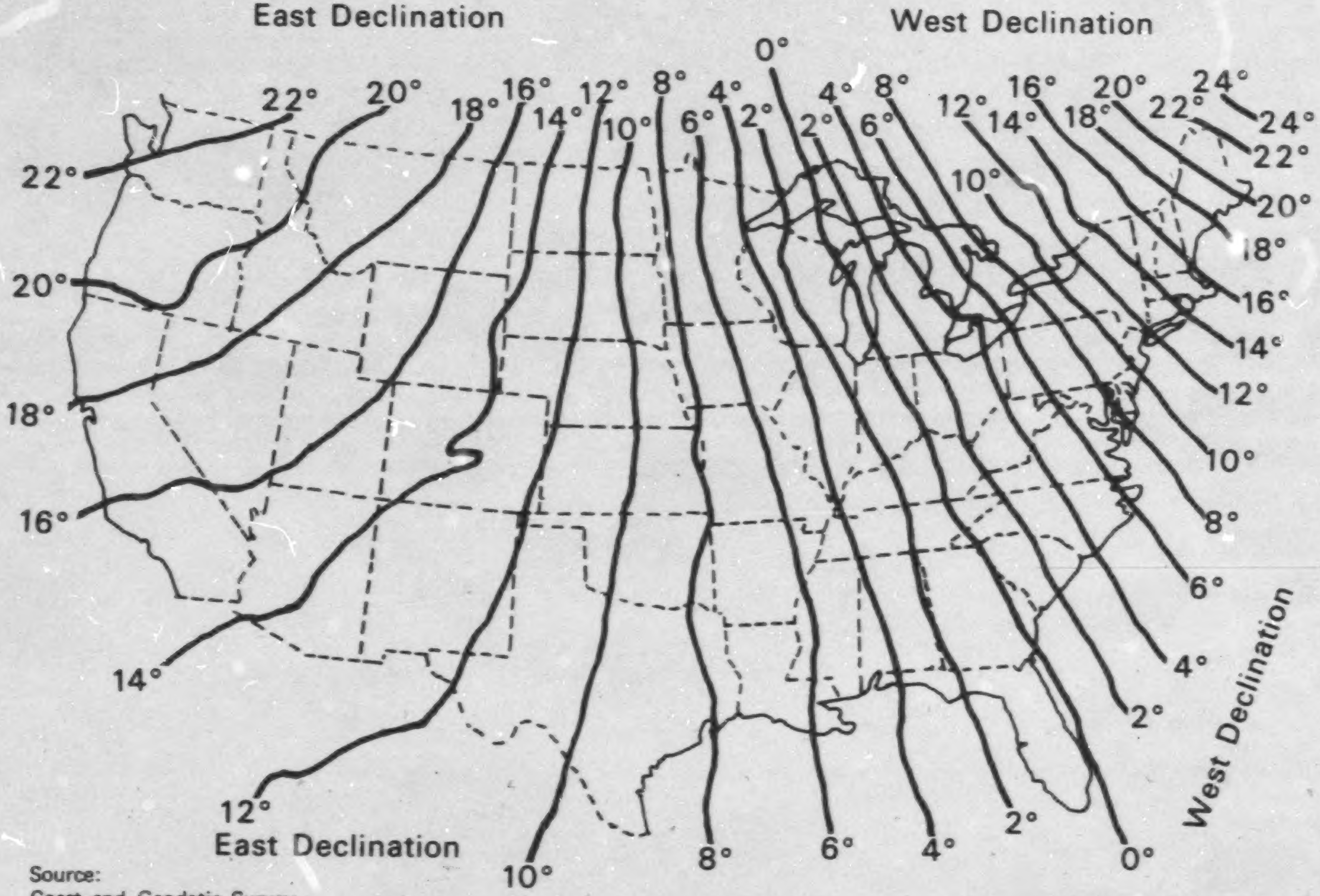


Azimuths and Bearings


N
30°
330°
0° 360°
30°
30°
60°
300°
60°
60°
NW
NE
W 90°
270°
90°
90° E
SW
SE
240°
60°
120°
60°
210°
30°
180°
150°
30°

AZIMUTH - INSIDE CIRCLE
BEARING - OUTSIDE CIRCLE

Isogonic Chart

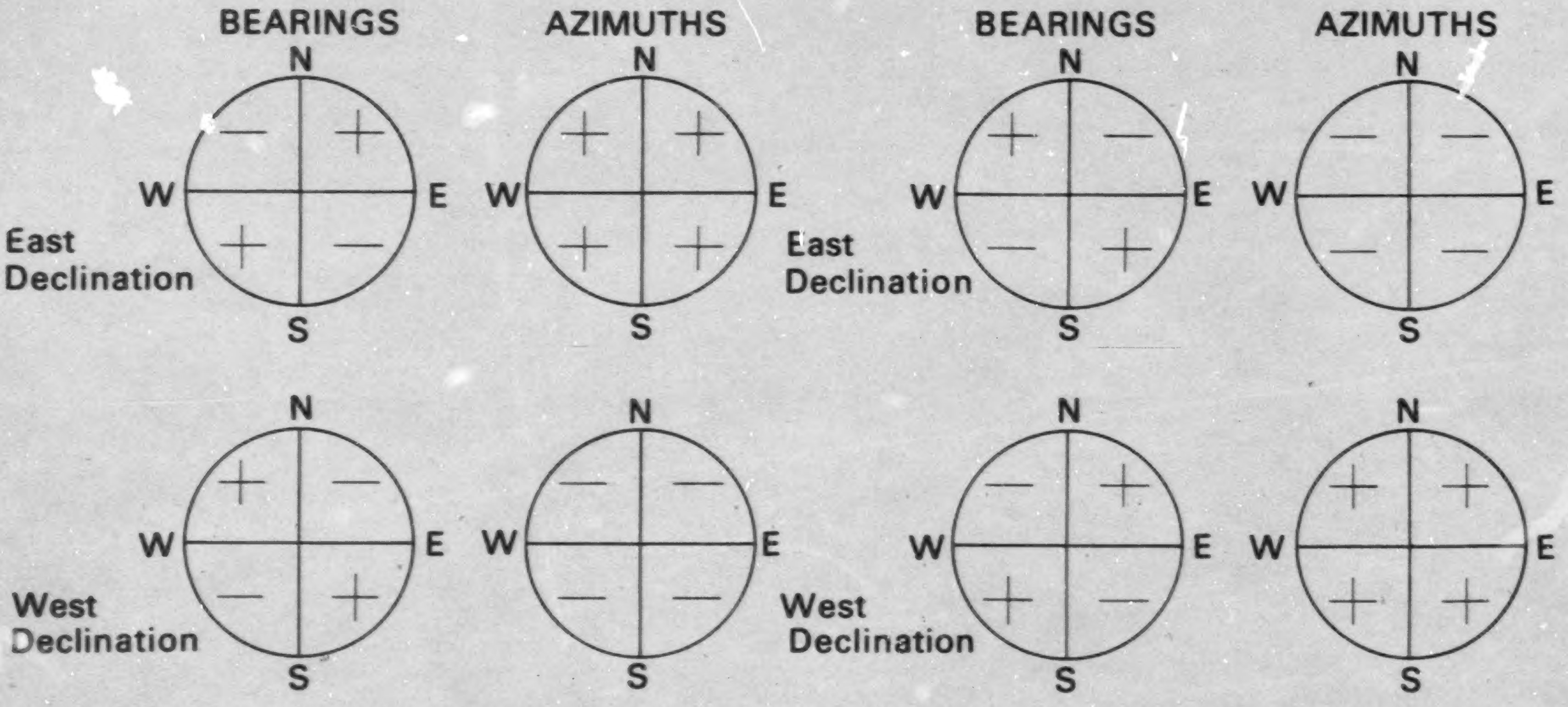

East Declination
West Declination
0°
22°
20°
18°
16°
14°
12°
10°
8°
6°
4°
2°
24°
22°
20°
18°
16°
14°
12°
10°
8°
6°
4°
2°
0°
12°
East Declination
10°
8°
6°
4°
2°
0°
West Declination

Source:
Coast and Geodetic Survey,
U.S. Dept. of Commerce.

Angle Corrections

Recording True Angles From Magnetic Readings

Reading Magnetic Angles For True Directions


BEARINGS
AZIMUTHS
BEARINGS
AZIMUTHS
N
—
+
W
E
+
—
S
East Declination
N
+
+
W
E
+
+
S
N
+
—
W
E
—
+
S
East Declination
N
—
—
W
E
—
—
S
N
+
—
W
E
—
+
S
West Declination
N
—
—
W
E
—
—
S
N
—
+
W
E
+
—
S
West Declination
N
+
+
W
E
+
+
S

FOREST SURVEYING
UNIT I

ASSIGNMENT SHEET #1--DETERMINE AZIMUTHS AND BEARINGS

1. Write the azimuths for these bearings.

   a. N61°W ____________________

   b. S45°W ____________________

   c. S83°E ____________________

   d. N83°E ____________________

2. Give back sights for both the bearings and azimuths for the above listed bearings.

	Bearings	Azimuths
a.	____________________	____________________
b.	____________________	____________________
c.	____________________	____________________
d.	____________________	____________________

3. Write the true azimuths for the following magnetic readings using a magnetic declination of 8°E.

   a. 47° ____________________

   b. 262° ____________________

   c. 354° ____________________

4. Correct the following magnetic bearings to true bearings for an area that has a magnetic declination of 10°W.

   a. N61°E ____________________

   b. S55°E ____________________

   c. N2°W ____________________

FOREST SURVEYING
UNIT I

ANSWERS TO ASSIGNMENT SHEET

1. a. 299°
   b. 225°
   c. 97°
   d. 83°

2.

	Bearings	Azimuths
a.	S61°E	119°
b.	N45°E	45°
c.	N83°W	277°
d.	S83°W	263°

3. a. 55°
   b. 270°
   c. 2°

4. a. N51°E
   b. S65°E
   c. N12°W

FOREST SURVEYING
UNIT I

JOB SHEET #1--DEVELOP PACING SKILL

(NOTE: Students should be able to pace within an accuracy of 1 part in 80 parts of distance.)

I. Tools and materials needed

- A. Steel tape
- B. Areas indicated by the instructor

II. Procedure

- A. Group in teams of two, head chainman and rear chainman
- B. After demonstration of the use of a tape by the instructor, uncoil the steel tape to avoid kinks
- C. Measure a distance of 10 chains in the direction and area given by the instructor using these steps:
    1. Head chainman pulls "O" end of chain
    2. Head chainman kept in line by rear chainman with the use of a compass
    3. Rear chainman calls "chain" as tape reaches desired graduation of measurement
    4. Head chainman pulls chain taut (20 lbs.) and if necessary aligns tape
    5. Rear chainman yells "stick" when alignment is adequate
    6. Head chainman marks the point under the "O" graduation and calls "stuck"
- D. Procedure is repeated until 10 chains are measured
- E. Each member of the teams then paces the 10 chains twice to obtain an average step taken per chain
- F. Fill in the following:
    1. Average steps per chain ____________
    2. Number of feet per chain ____________
    3. Number of links per chain ____________

JOB SHEET #1

4. Distance of one link ____________

5. Distance of one rod ____________

G. Pace the distance in total chains and links between two points indicated by the instructor

H. Fill in the distance as paced here ____________

I. Turn in to the instructor for evaluation

FOREST SURVEYING
UNIT I

JOB SHEET #2--MEASURE HORIZONTAL DISTANCE ALONG A SLOPE

Group students in teams of two. Determine the horizontal distance between two points designated by the instructor. Determine the distance within an accuracy of 1 part in 1,000. When completed, turn in measurement to the instructor for evaluation.

I. Tools and materials needed

   A. Slope

   B. Abney hand level

   C. Two points designated by the instructor

   D. Pencil and paper

   E. Clipboard

II. Procedure

   A. Obtain Abney hand level readings along slope

   B. Obtain trailer readings corresponding to the Abney readings

   C. Extend the tape the distance indicated on the trailer

   D. Use the six steps for measurement with the steel tape as outlined in Job Sheet #1

FOREST SURVEYING
UNIT I

TEST

1. Match the terms on the right to the correct definition.

_____a. Determining a horizontal distance using a natural walking gait

_____b. Measuring a horizontal distance with tape or chain

_____c. The original tool for measuring distance in the woods; it is 66 feet long and is composed of 100 links of stout wire, each 7.92" long

_____d. A narrow strip of steel marked off in graduations for measuring length

_____e. One-fourth of a chain or 16 1/2 feet in distance; originated from a chicken house perch pole from England

_____f. Topographic steel trailer tape for measuring horizontal distance on slopes

_____g. An instrument that measures the angle between the horizontal plane and the line of sight along a slope

_____h. Measuring a distance of less than full chains due to an obstacle

_____i. A method of coiling the steel tape for storage and transport

_____j. An instrument used to find horizontal angles; gives direction

_____k. A horizontal angle measured clockwise from 0° to 360°

1. Tape
2. Compass
3. Abney hand level
4. Magnetic declination
5. Bearing
6. Slope tape
7. Chain
8. Throwing-the-chain
9. Pacing
10. Pole
11. Azimuth
12. Back sight
13. Chaining
14. Breaking-the-chain

_____l. A horizontal angle measured from north to south in an each or west direction up to 90°; compass face is divided into four quadrants

_____m. The correction in horizontal angle needed to convert magnetic readings to true readings

_____n. A horizontal angle read 180° from a corresponding foresight

2. List two methods used to measure horizontal distances.

a.

b.

3. List the types of tapes used in forest surveying.

a.

b.

c.

4. Arrange in order the steps followed in chaining horizontal distances. Place in numerical order.

_____a. Head chainman pulls chain taut (20 lbs.) and if necessary aligns tape

_____b. Head chainman kept in line by rear chainman with the use of a compass

_____c. Head chainman plumb bobs the "O" mark or "eyeballs it" and marks with a chaining pin; then he yells "stuck"

_____d. Head chainman pulls "O" end of chain

_____e. Rear chainman calls "chain" as tape reaches the desired graduation of measurement

_____f. Rear chainman yells "stick" when alignment is adequate

5. Arrange in order the steps followed in chaining along slopes.

_____a. Obtain trailer readings corresponding to the Abney readings

_____b. Obtain Abney hand level readings along slope

_____c. Extend the tape the distance indicated on the trailer

6. Tell how to measure around obstacles and inaccessible lines with a tape.

7. List the three essential parts and three accessories of a compass.

a. Essentials	b. Accessories
1)	1)
2)	2)
3)	3)

8. List the two directions obtained from a compass.

a.

b.

9. List three ways to find magnetic declination.

a.

b.

c.

10. List the true azimuths and bearings for a magnetic declinations of 8° east for these magnetic angles.

Magnetic Angles		True Azimuths	True Bearings
Azimuth	24°	a. ______	c. ______
Azimuth	142°	b. ______	d. ______

11. List five guidelines to follow when reading a compass.

    a.

    b.

    c.

    d.

    e.

12. Demonstrate the ability to:

    a. Develop pacing skill.

    b. Measure horizontal distance along a slope.

    (NOTE: If these have not been accomplished prior to the test, ask the instructor when the above activities should be completed.)

FOREST SURVEYING
UNIT I

ANSWERS TO TEST

1. a. 9
   b. 13
   c. 7
   d. 1
   e. 10
   f. 6
   g. 3
   h. 14
   i. 8
   j. 2
   k. 11
   l. 5
   m. 4
   n. 12

2. a. Pacing
   b. Chaining

3. a. Surveyor's tape
   b. Slope tape
   c. Engineer's tape

4. a. 4
   b. 2
   c. 6
   d. 1
   e. 3
   f. 5

5. a. 2
   b. 1
   c. 3

6. a. Lay out a right angle
    1. Measure points A and B any distance
    2. Measure distance clear of the obstacle used as an arc from A and B

   b. Measure inaccessible lines
    1. To measure V-W, set a point O any distance and equal distance in line to Y
    2. Set U-X in line through O
    3. Set Z in line with O-W
    4. Measure Z-Y to equal the distance V-W

7. a. 1) Magnetized needle
      2) Pivot point
      3) Graduated housing

   b. 1) Magnetic declination adjustment
      2) Leveling device
      3) Sighting device

8. a. Azimuths
   b. Bearings

9. a. Isogonic charts
   b. Angle readings on Polaris (North Star)
   c. Reference survey line

10. a. 32°
    b. 150°
    c. N32°E
    d. S30°E

11. a. Level the compass
    b. Align sights properly
    c. Check to see that needle swings freely
    d. Read north end of needle
    e. Take back sight

12. Performance skills will be evaluated to the satisfaction of the instructor

FOREST LAND LOCATION
UNIT II

TERMINAL OBJECTIVE

After completion of this unit, the student should be able to interpret a legal land description and identify the tract of forest land property in the state of Oklahoma. He should be able to determine the number of acres and prepare a sketch of the property. This knowledge will be evidenced through demonstration and by scoring eighty-five percent on the unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms associated with forest land location to the correct definition.
2. List three reasons land location is a necessary forestry task.
3. Select from a list the three methods of land survey systems found in the United States.
4. Match a list of subdivisions of the rectangular system of survey to a sketch.
5. Determine the number of acres from a legal description by reading and by sketching.
6. Locate and label on a map the principle meridians and base lines of Oklahoma.
7. Match the type of public survey to a description of the line marking.
8. Match the survey corner to the correct corner marking description.
9. List three types of witness markings.
10. List five items of entry that can be found in survey field notes.
11. List the two locations where survey field notes may be obtained.

FOREST LAND LOCATION
UNIT II

SUGGESTED ACTIVITIES

I. Instructor:

- A. Provide students with objective sheet.
- B. Provide students with information and assignment sheets.
- C. Make transparencies.
- D. Discuss terminal and specific objectives.
- E. Discuss information and assignment sheets.
- F. Arrange field trips to allow students an opportunity to locate property corners.
- G. Give test.

II. Students:

- A. Read objectives.
- B. Study information sheet.
- C. Complete assignment sheets.
- D. Participate in field trip.
- E. Take test.

INSTRUCTIONAL MATERIALS

I. Included in this unit:

- A. Objectives
- B. Information sheets
- C. Transparency masters
    1. TM 1–Land Survey Systems
    2. TM 2–Rectangular System Subdivisions
    3. TM 3–System of Section Line Location

    4. TM 4–Division of a Section
    5. TM 5–Lots
    6. TM 6–Principal Meridians and Baselines

D. Assignment sheets

    1. Assignment Sheet #1–Identify Townships and Sections
    2. Assignment Sheet #2–Interpret Legal Descriptions

E. Answers to assignment sheets

F. Test

G. Answers to test

II. References:

A. Avery, T. Eugene. *Forest Measurements.* New York: The Ronald Press Co.

B. Forber, Reginald D. *Forestry Handbook.* New York: The Ronald Press Co.

C. Kissam, Philip. *Surveying Practice.* New York: McGraw-Hill Book Co.

D. Moffitt, Francis H. *Surveying.* Scrantion, Pennsylvania: International Textbook Co.

FOREST LAND LOCATION
UNIT II

INFORMATION SHEET

I. Terms and definitions

A. Bearing--Horizontal angle measured from north or south and referenced to one of the quadrants of the compass

B. Legal description of land--The survey record of the parcelling of land according to a prescribed method by law; the deed description of property

C. Initial point--The origin of a survey system established by astronomical observation

D. Base line--The latitude, true east and west line, that intersects the principal meridians at the initial point

E. Standard parallels--Lines surveyed every 24 miles north and south of and parallel with the base line

F. Principal meridian--The longitude, true north and south line, that intersects the base line at the initial point

G. Guide meridians--True meridians extended north from the base line or from standard parallels at intervals of 24 miles east and west from the principal meridian

H. Township (T)--Division of territory six miles long on its south, east, and west boundaries and slightly less than six miles on the north, which accounts for the correction lines located every six miles on the standard parallel

I. Range (R)--Row or line of north-south townships, six miles apart and numbered consecutively east or west from the principal meridian

J. Section (SEC.)--Composed of approximately 640 acres and measures approximately one square mile

(NOTE: North and west tier of sections within a township may be more or less than one square mile, usually less.)

K. Quarter-section (1/4)--Consists of approximately 160 acres and designated as northeast (NE), southeast (SE), northwest (NW), or southwest (SW)

(NOTE: Quarter-sections bordering the west and north side of the township do not always contain 160 acres.)

INFORMATION SHEET

L. Correction lot--Fractional 40 acre tracts found on the west and north border of a township

M. River lot--Fractional 40 acre tracts found along rivers that have a mean high water mark of 132 feet or more

(NOTE: Area between high water mark belongs to state thus reducing the size to less than a 40 acre tract.)

II. Reasons for land location in forestry

A. Retrace old lines

B. Locate property boundries

C. Measure land areas not publicly surveyed

III. United States land survey systems (Transparency 1)

A. Metes and bounds--Original thirteen colonies

B. Vara--In Texas

C. Rectangular system--All states except the above

IV. Rectangular system subdivisions (Transparency 2)

A. Initial point--Formed by the intersection of base line and principal meridian

B. Twenty-four mile correction tracts--Formed by the standard parallels and guide meridians

C. Townships

1. East-west tier of townships is numbered consecutively, north or south from the base line

Example: Township 16 North (T16N) or Township 3 South (T3S)

2. Each range is numbered consecutively east or west from the

Example: Range 19 East (R19E) or Range 1 West (R1W)

D. Location of sections within township (Transparency 3)

1. Numbering begins with 1 in upper right hand corner and proceeds in a serpentine fashion to the bottom right-hand corner of township

2. Show survey procedure followed to establish section lines within township

INFORMATION SHEET

E. Subdivision of sections (Transparency 4)

   1. Tracts of 320, 160, 80, 40, 20, and 10 acres with descriptions of halves and quarters

   2. Correction lots (Transparency 5)

   3. River lots (Transparency 5)

V. Determining the acres of land from a legal description

   A. Read and write legal descriptions

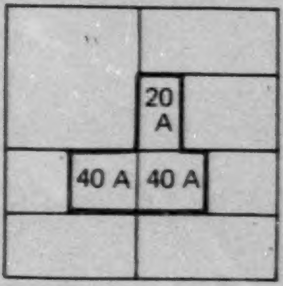
      1. From right to left

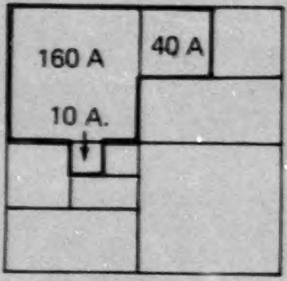
      2. Tract subdivisions are continuous--Separate tracts are divided by and, &, or a ;

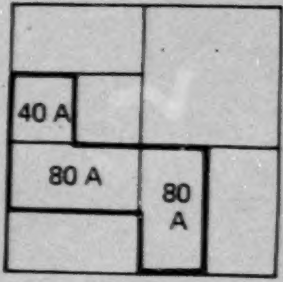
         (NOTE: Two letters alone mean 1/4, while a single letter means 1/2.)

   B. Sketch to scale

      Examples:


NESW;W½SWNE;
NWSE Sec.10


NW¼NE¼SW¼&NW¼
&NW¼NE¼ Sec. 10


NSW&SWNW
&ESE Sec. 30

VI. Principal meridians and base lines of Oklahoma (Transparency 6)

   A. Cimarron Meridian (CM)--Intersects with base line; initial point for panhandle counties

   B. Indian Meridian (IM)--Intersects with base line in Murray County; initial point for main body of Oklahoma

INFORMATION SHEET

VII. Survey line markings

  A. Townships--Three blazes and hacks

  B. Sections--Two blazes and hacks

  C. Section subdivisions--One blaze and hack

  (NOTE: On line trees use a hack, a horizontal notch on each side of trees intersected with a survey line. On adjacent trees use a blaze, a vertical scribe usually made with an ax, on trees facing the survey line. Various paint markings are used: U. S. Forest Service uses red; Weyerhaueser uses white exterior lines and orange interior lines; and other landowners use various colors. There is no standard.)

VIII. Corner markings in legal survey

  A. Township corners

    1. Corners placed every mile and one-half mile

    2. Marked on two sides along with direction of survey with one notch for each mile of distance to the next intersecting township line

  B. Section corner

    1. Marked according to the location of the section corner from the southeast corner of the township

    2. Horizontal notches placed on the south and east face of the rock with one notch for each mile of distance to the SE, corner of the township

  C. Quarter corners

    1. East-West lines--Marked 1/4 on north face

    2. North-South lines--Marked 1/4 on west face

  D. Legal resurveyed corners--Iron pipe with brass cap tooled with township, section, or 1/4 corner represented

  (NOTE: Materials used include sandstone, charred stakes, buried charcoal, glassware, or pieces of metal. Generally, sandstone is used.)

IX. Witness markings

  A. Bearing trees

  B. Bearing object

  (NOTE: This includes a natural rock formation, railroad trestle, mound of stone, or other durable material chiseled with an "X" or "BO". The distance and bearing is recorded in the field notes.)

INFORMATON SHEET

C. Pits and mounds

(NOTE: Holes are dug in opposite section corners and the dirt is used to build mounds.)

X. Items of entry for survey field notes

A. Precise course and length of lines

B. Kinds and diameter of bearing trees with distance and bearing

C. Corner description

D. Intersections with land objects

E. Intersections with water objects

F. Surface of the land

G. Roads and trails

H. Other entries of report on the character of the land, soil, water, and timber

Example on following page

INFORMATION SHEET

UNITED STATES PUBLIC LAND SURVEYS

Chains Beginning the subdivisional survey at the cor. of secs. 1, 2, 35 and 36, on the S. bdy, of the Tp., which is monumented with a sandstone 8 x 6 x 5 ins. above ground, firmly set, marked and witnessed as described in the official record.

N. 0° 01' W., bet. secs. 35 and 36.

Over level bottom land.

20.00 Enter scattering timber.

29.30 S.E. cor. of field; leave scattering timber.

31.50 A cabin bears West, 6.00 chs. dist.

39.50 Enter State Highway No. 25, bears N. along section line, and E.

40.00 Point for the 1/4 sec. cor. of secs. 35 and 36.

Bury a granite stone, 12 x 12 x 12 ins., mkd. X, 2 ft. underground, from which

An iron post, 30 ins. long, 2 ins. diam., set 24 ins. in the ground, for a reference monument, with brass cap mkd. with an arrow pointing to the cor. and 1/4 S 36 RM, bears East 46 lks. dist.

An iron post 30 ins. long, 2 ins. diam., set 24 ins. in the ground, for a reference monument with brass cap mkd. with an arrow pointing to the cor. and 1/4 S 35 RM, bears West 46 lks. dist.

50.50 N.E. cor. of field.

51.50 Highway turns to N. 70° W.

57.50 Enter heavy timber and dense undergrowth, edge bears N. 54° E. and S. 54° W.

72.00 Leave undergrowth.

80.00 Point for the cor. of secs. 25, 26, 35, and 36.

Set an iron post. 30 ins. long, 2 ins. diam., 24 ins. in the ground with brass cap mkd.

T 15 N R 20 E
S 26 S 25
S 35 S 36
1945

from which

A green ash, 13 ins. diam., bears N. 22° E., 26 lks. dist. mkd. T 15 N R 20 E S 25 BT.

A green ash, 23 ins. diam., bears S. 71 1/4° E., 37 lks. dist. mkd. T 15 N R 20 E S 36 BT.

A green ash, 17 ins. diam., bears S. 64° W., 41 lks. dist. mkd. T 15 N R 20 E S 35 BT.

A cottonwood, 13 ins. diam., bears N. 21 1/4° W., 36 lks. dist. mkd. T 15 N R 20 E S 26 BT.

Land, level bottom; northern 20 chs. subject to overflow.

Soil, alluvial, silt and loam.

Timber, green ash and cottonwood; undergrowth, willow.

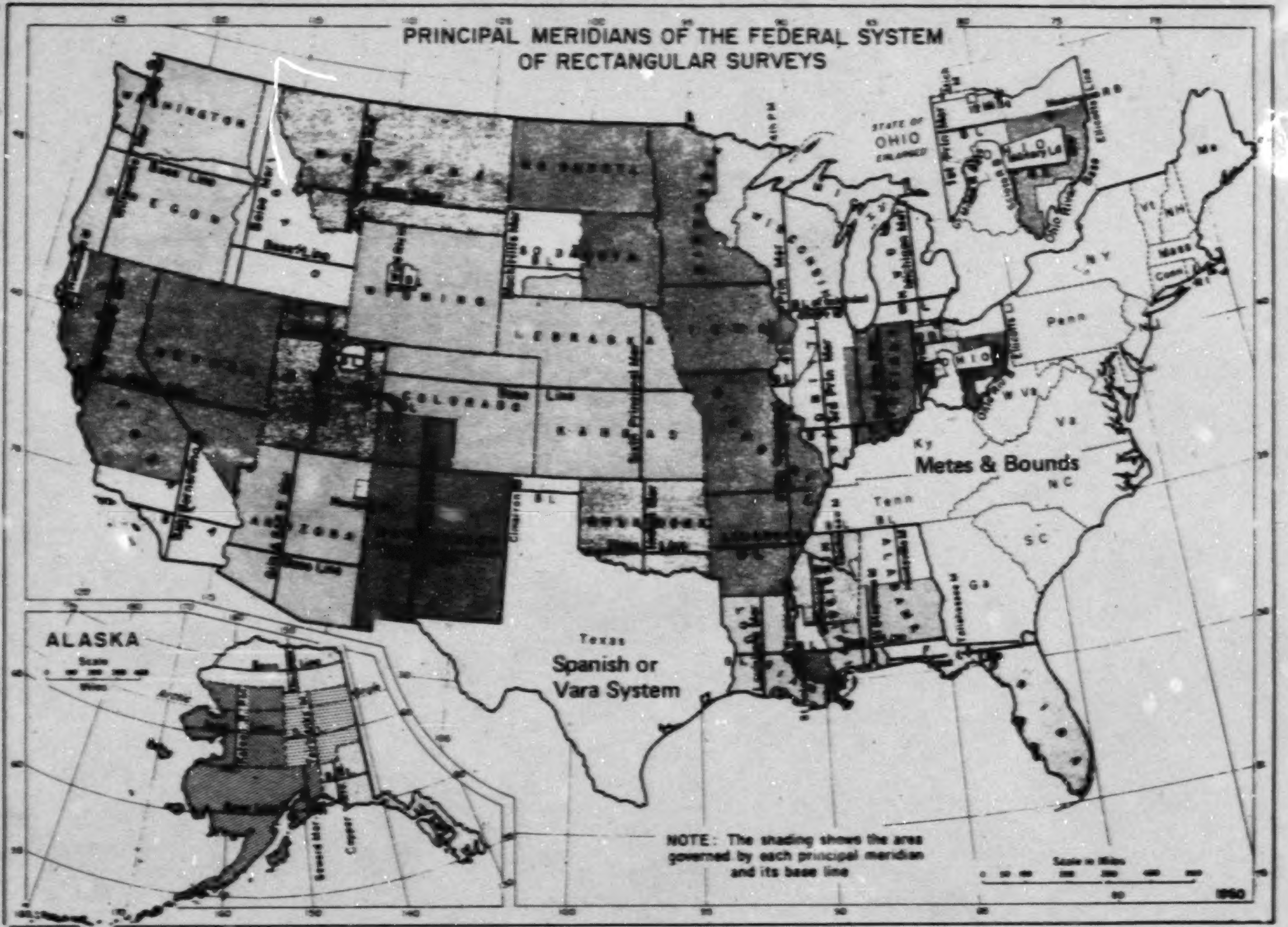
INFORMATON SHEET

XI. Locations of field notes

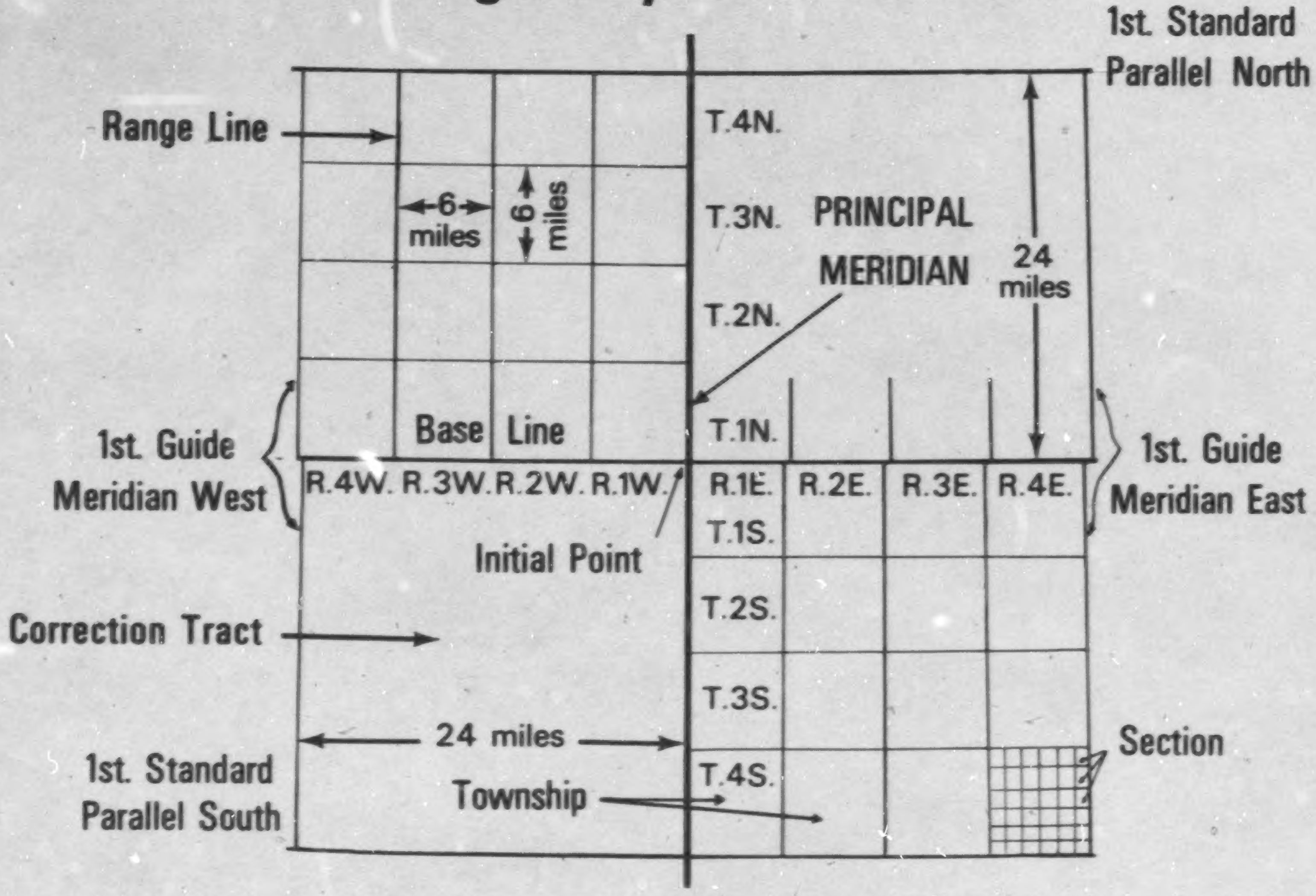
A. Bureau of Land Mangement, Washington, D.C.

B. County courthouse in the office of county clerk, county surveyor, or some other similar county official

Land Survey Systems


PRINCIPAL MERIDIANS OF THE FEDERAL SYSTEM OF RECTANGULAR SURVEYS
STATE OF OHIO ENLARGED
Washington
Oregon
Montana
Idaho
Wyoming
Nevada
Utah
Colorado
Arizona
New Mexico
N. Dakota
So. Dakota
Nebraska
Kansas
Oklahoma
Minnesota
Iowa
Missouri
Arkansas
Louisiana
Wisconsin
Michigan
Illinois
Indiana
Ohio
Mississippi
Alabama
Florida
Me
Vt
NH
Mass
Conn
RI
NY
NJ
Penn
W Va
Va
Ky
NC
Tenn
SC
Ga
Metes & Bounds
Texas
Spanish or Vara System
Base Line
Cimarron
Sixth Principal Mer.
ALASKA
Scale
Miles
NOTE: The shading shows the area governed by each principal meridian and its base line
Scale in Miles
1960

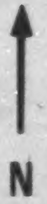
Rectangular System Subdivisions


1st. Standard Parallel North
Range Line
T.4N.
6 miles
6 miles
T.3N.
PRINCIPAL MERIDIAN
24 miles
T.2N.
Base Line
T.1N.
1st. Guide Meridian West
1st. Guide Meridian East
R.4W.
R.3W.
R.2W.
R.1W.
R.1E.
R.2E.
R.3E.
R.4E.
T.1S.
Initial Point
Correction Tract
T.2S.
T.3S.
24 miles
Section
1st. Standard Parallel South
T.4S.
Township

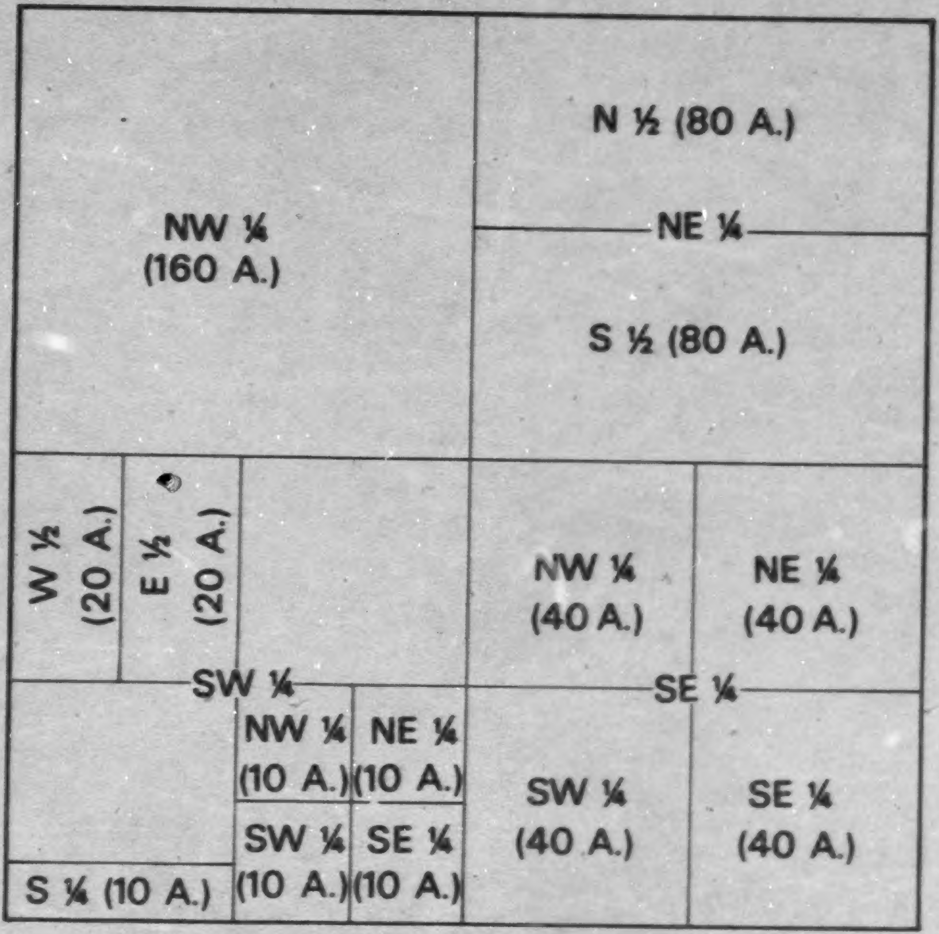
The location of the initial point, base line, principal meridian, standard parallels, guide meridians, ranges, townships, and sections.

System of Section Line Location

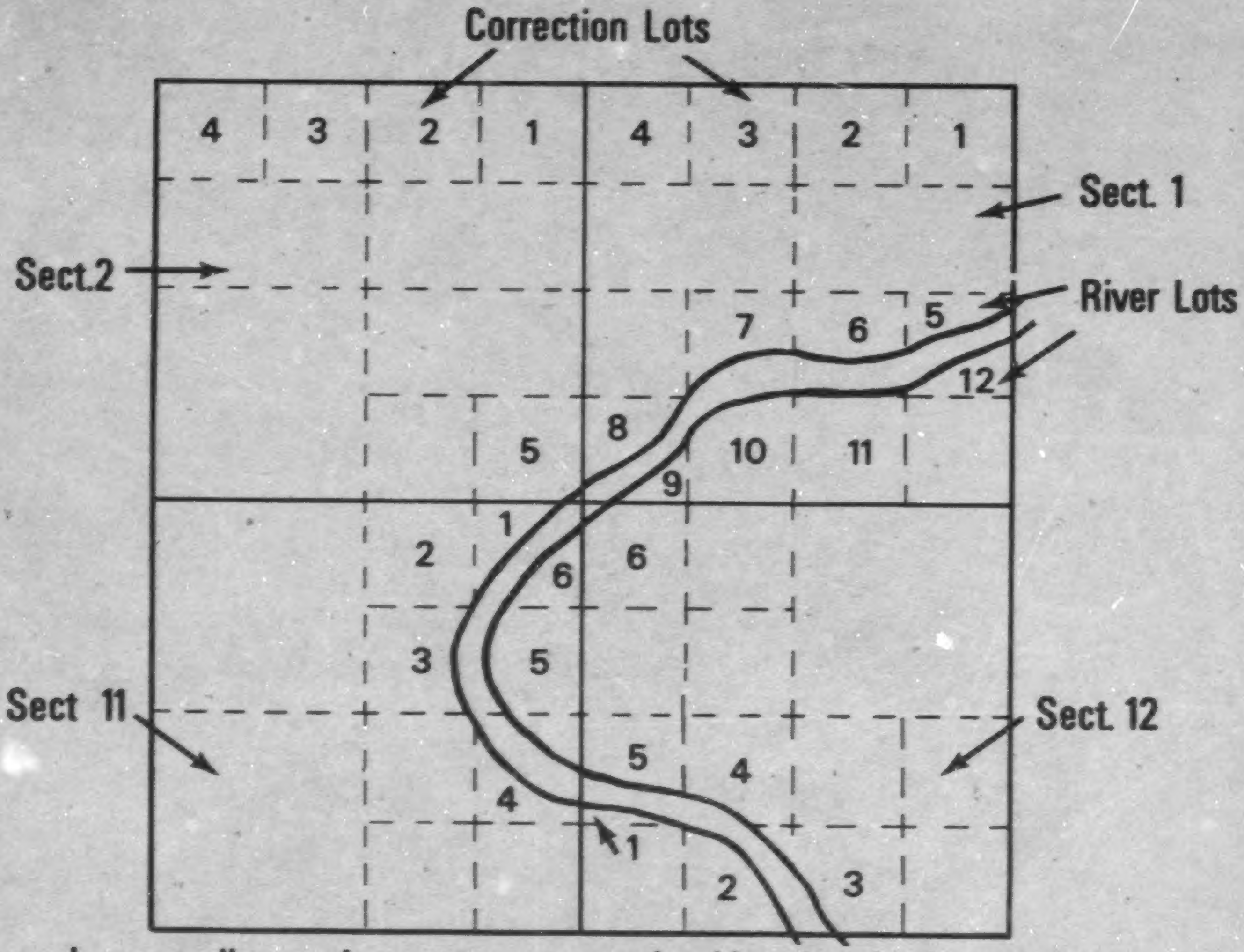
6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36



Division of a Section

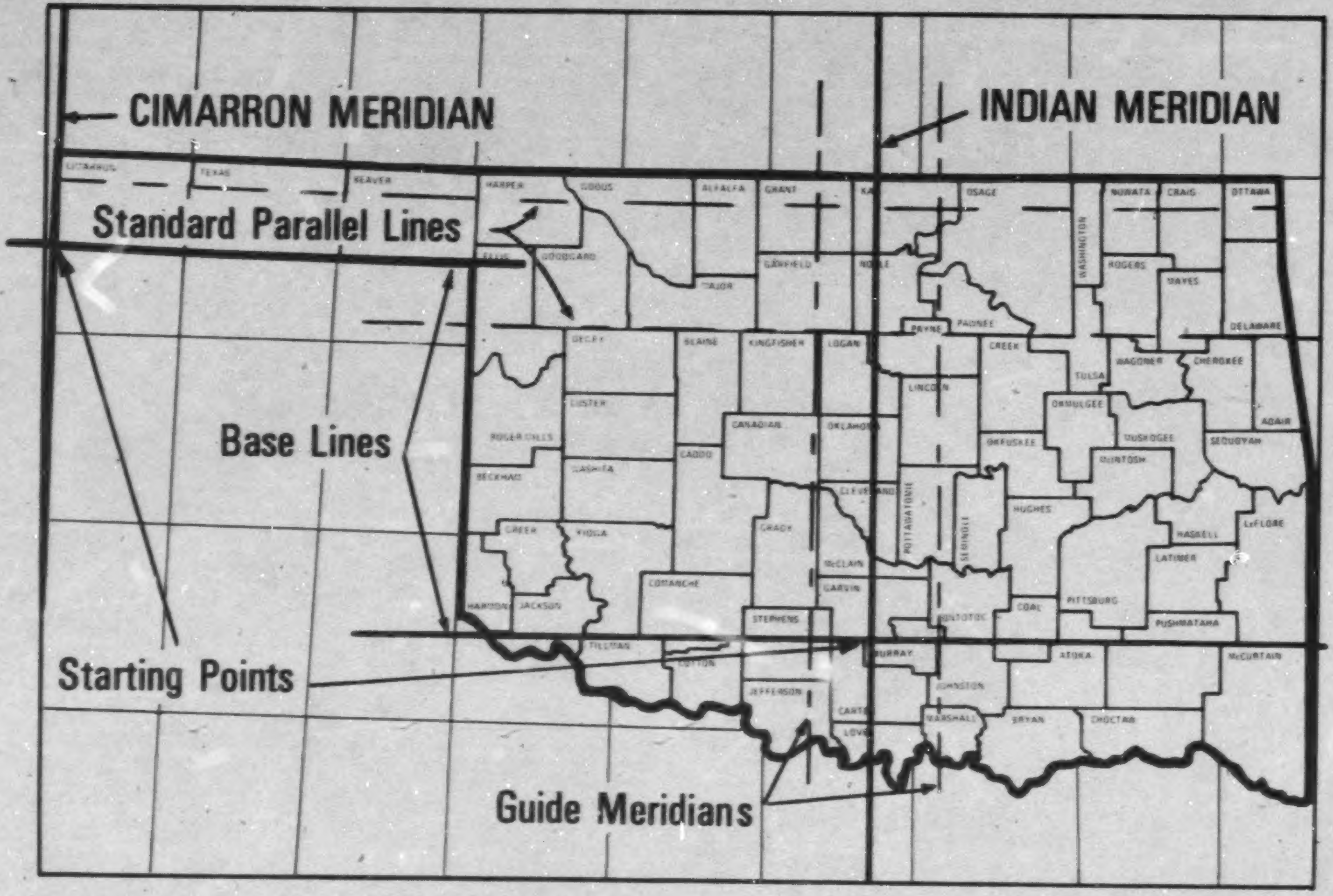

NW ¼
(160 A.)
N ½ (80 A.)
NE ¼
S ½ (80 A.)
W ½
(20 A.)
E ½
(20 A.)
SW ¼
NW ¼
(40 A.)
NE ¼
(40 A.)
SE ¼
NW ¼
(10 A.)
NE ¼
(10 A.)
SW ¼
(10 A.)
SE ¼
(10 A.)
S ¼ (10 A.)
SW ¼
(40 A.)
SE ¼
(40 A.)

Lots


Correction Lots
4
3
2
1
4
3
2
1
Sect. 1
Sect.2
River Lots
7
6
5
12
8
5
10
11
9
1
2
6
6
3
5
Sect 11
Sect. 12
5
4
4
1
2
3

Lot numbers usually run downstream to section Line then back upstream to line.

Principal Meridians and Baselines


CIMARRON MERIDIAN
INDIAN MERIDIAN
Standard Parallel Lines
Base Lines
Starting Points
Guide Meridians

Location of the two principal meridians (—) and base lines (—) in Oklahoma. Two guide meridians (—–—) and two standard parallel lines (---) are also shown.

FOREST LAND LOCATION
UNIT II

ASSIGNMENT SHEET #1–IDENTIFY TOWNSHIPS AND SECTIONS

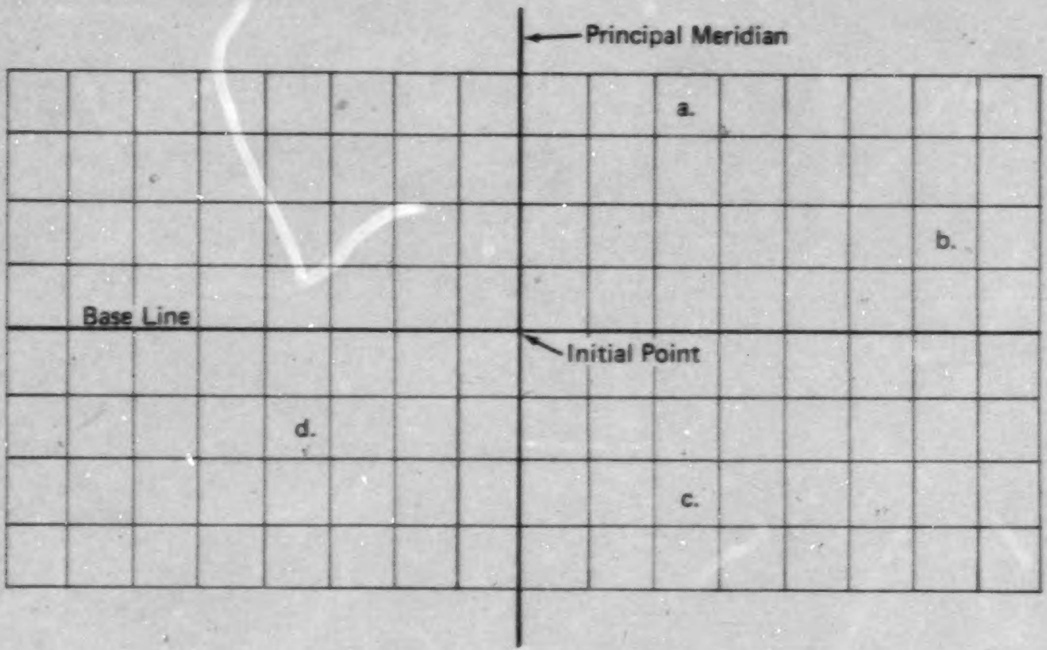
1. Identify by writing the legal description of the following townships.

   a. ______________

   b. ______________

   c. ______________

   d. ______________


Principal Meridian
a.
b.
Base Line
Initial Point
d.
c.

ASSIGNMENT SHEET #1

2. Number the sections within the township drawn below.

3. Give the proper section number for the sections marked in this township:

a. _____

b. _____

c. _____

d. _____

e. _____

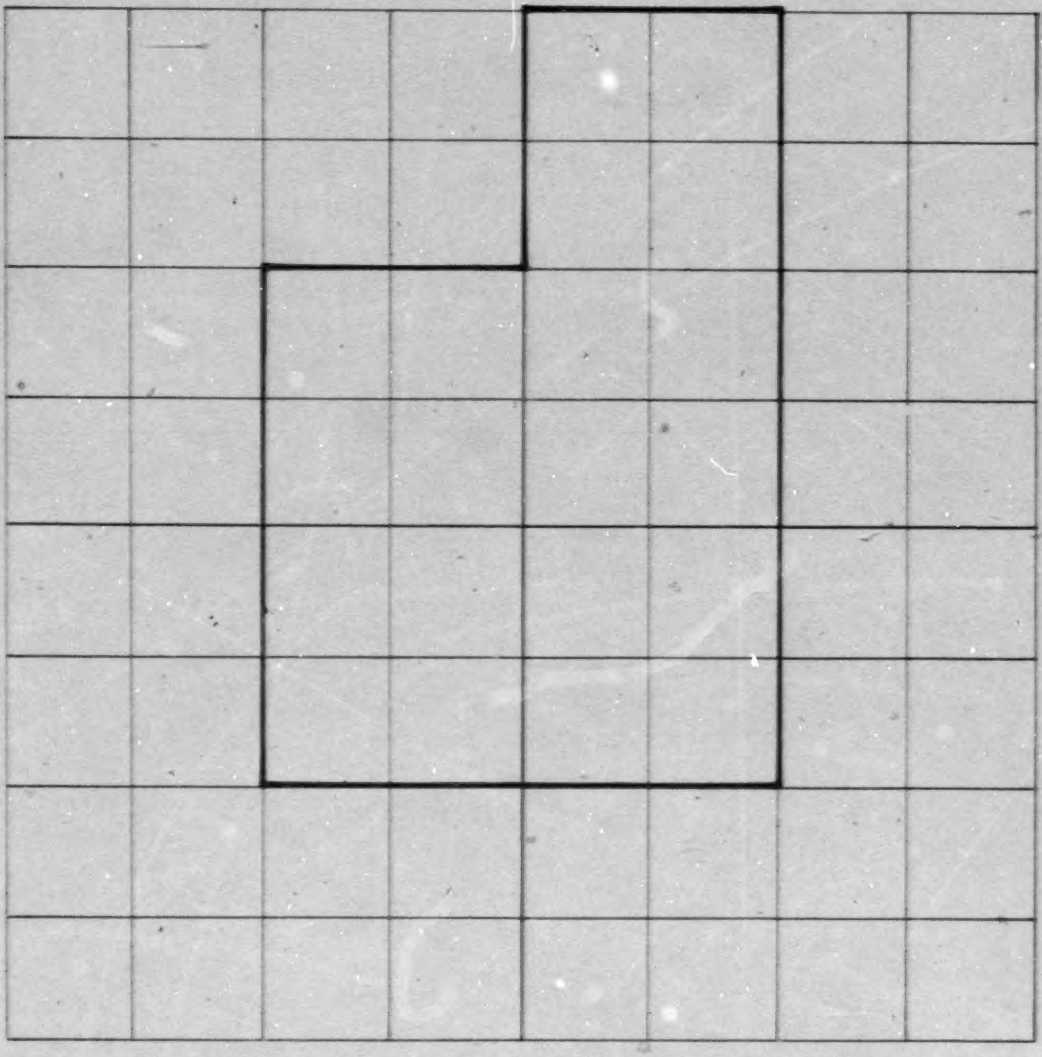
			a		
	b				
c					
d					e

FOREST LAND LOCATION
UNIT II

ASSIGNMENT SHEET #2–INTERPRET LEGAL DESCRIPTIONS

1. For the following plat sheet sketch, determine the total acres in the tract and its complete legal description.

   a. Acres ____________ b. Description ____________



Scale 6" = 1 Mile

ASSIGNMENT SHEET #2

2. Suppose the landowner in the first problem bought 100 acres of land with the following legal description:

   NENW and SWNW and S1/2NWNW Section 16, T6N,R19E

   Sketch in the additional acres on the plat sheet.

3. How many acres are in the following described tracts?

   a. SW and N1/2 Sec. 2__________

   b. S1/2 S1/2 SE and S1/2NE Sec. 14__________

   c. SE;SESWSE Sec. 3 and N1/2NW Sec. 2__________

   d. W1/2 Sec. 6 and NWNWNW Sec. 7________

   e. N1/2 SESE Sec. 33 and Sec. 34__________

4. Describe in legal terms the fractional parts of the following

a. __________

b. __________

c. __________

d. __________

e. __________

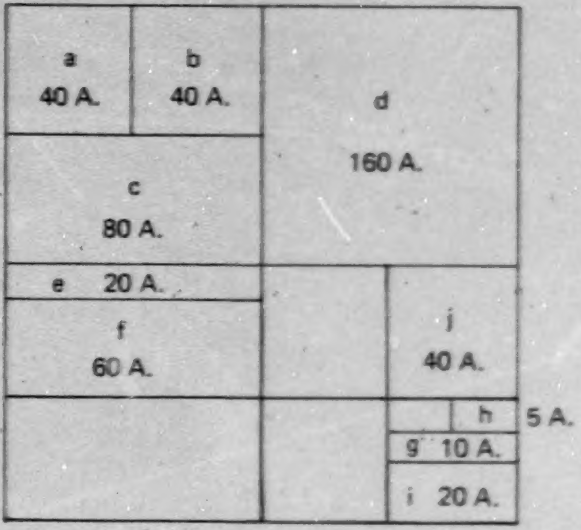
f. __________

g. __________

h. __________

i. __________

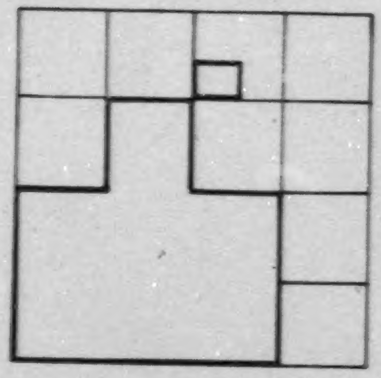
j. __________



ASSIGNMENT SHEET #2

5. What is the legal description for the following sketch of property?

____________ ____________ Sec 11 T3N R19E



FOREST LAND LOCATION
UNIT II

ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheet #1

1. a. T4N, R3E

   b. T2N, R7E

   c. T3S, R3E

   d. T2S, R4W

2.

↑ N

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

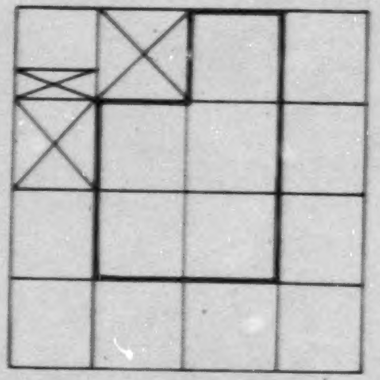
3. a. 3 b. 8 c. 30 d. 31 e. 36

Assignment Sheet #2

1. a. 200

   b. NWSE; W1/2NE; SENW; NESW

2.



3. a. 240
   b. 120
   c. 250
   d. 330
   e. 660
4. a. NWNW
   b. NENW
   c. S1/2NW
   d. NE
   e. N1/2N1/2N1/2SW
   f. S1/2N1/2N1/2SW and S1/2N1/2SW
   g. S1/2N1/2SESE
   h. E1/2N1/2N1/2SESE
   i. S1/2SESE
   j. NESE
5. SWNWNE; SENW; SW; W1/2SW

FOREST LAND LOCATION
UNIT II

TEST

1. Match the terms on the right to the correct definition.

______a. Horizontal angle measured from north or south and referenced to one of the quadrants of the compass

______b. The survey record of the parcelling of land according to a prescribed method by law; the deed description of property

______c. The origin of a survey system established by astronomical observation

______d. The latitude, true east and west line, that intersects the principal meridians at the initial point

______e. Lines surveyed every 24 miles north and south of and parallel with the base line

______f. The longitude, true north and and south line, that intersects the base line at the initial point

______g. True meridians extended north from the base line or from standard parallels at intervals of 24 miles east and west from the principal meridian

______h. Division of territory six miles long on its south, east, and west boundaries and slightly less than six miles on the standard parallel

______i. Row or line of north-south townships, six miles apart and numbered consecutively east or west from the principal meridian

______j. Composed of approximately 640 acres and measures approximately one square mile

1. River lot
2. Initial point
3. Principal meridian
4. Standard parallels
5. Range
6. Township
7. Quarter-section
8. Guide meridians
9. Bearing
10. Base line
11. Correction lot
12. Section
13. Legal description of land

_____k. Consists of approximately 160 acres and designated as northeast (NE), southeast (SE), northwest (NW), or southwest (SW)

_____l. Fractional 40 acre tracts found on the west and north border of a township

_____m. Fractional 40 acre tracts found along rivers that have a mean high water mark of 132 feet or more

2. List three reasons land location is a necessary forestry task.

   a.

   b.

   c.

3. Select from the list below the three methods of land survey systems found in the United States by circling the correct answers.

   a. Square-area

   b. Metes and bounds

   c. North and south

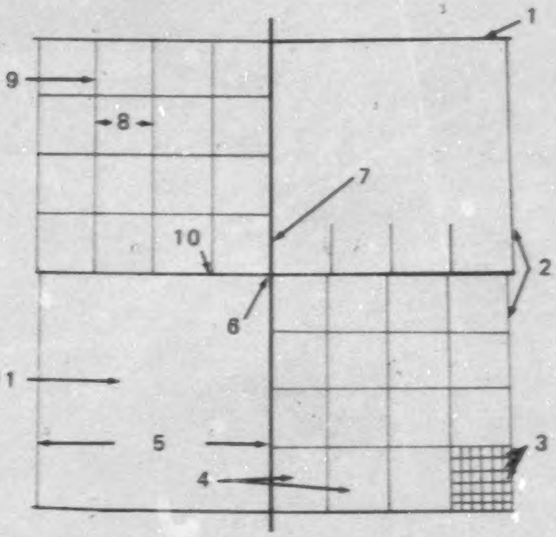
   d. Rectangular system

   e. Arpent

   f. Vara

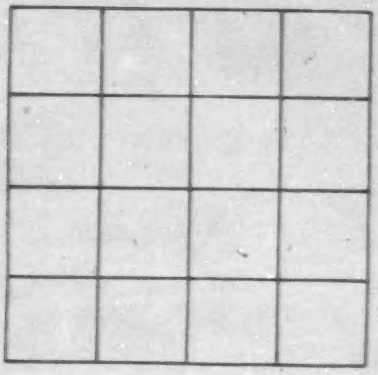
4. Match the following list of subdivisions of the rectangular system of survey to the sketch below, by placing the appropriate number in the blank.

_____a. Initial point
_____b. Base line
_____c. Guide meridian
_____d. Range line
_____e. Section
_____f. Principal meridian
_____g. Township
_____h. Standard parallel
_____i. Correction tract
_____j. 6 miles
_____k. 24 miles

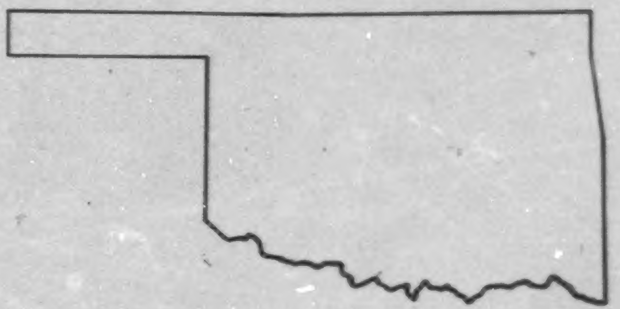


5. Determine the number of acres from the legal description of SESWNW; NWSE; N1/2SW Section 10 T4N R18E sketching the property on the following section diagram.

_____acres



6. Locate and label the principal meridians and base lines of Oklahoma on the following map.



7. Match the type of public survey to the description of the line marking.

_____a. Two blazes and hacks

_____b. Three blazes and hacks

_____c. One blaze and hack

1. Townships
2. Sections
3. Section subdivisions

8. Match the survey corner to the correct corner marking description.

_____a. Marked on two sides along the direction of survey with one notch for each mile of distance to the next intersecting township line

_____b. Horizontal notches placed on the south and east face of the rock with one notch for each mile of distance to the SE corner of the township

_____c. Marked with 1/4 on the north or west face

1. Section corner
2. Quarter corner
3. Township corner

9. List three types of witness markings.

a.

b.

c.

10. List five items of entry that can be found in survey field notes.

a.

b.

c.

d.

e.

11. List the two locations where survey field notes may be obtained.

a.

b.

FOREST LAND LOCATION
UNIT II

ANSWERS TO TEST

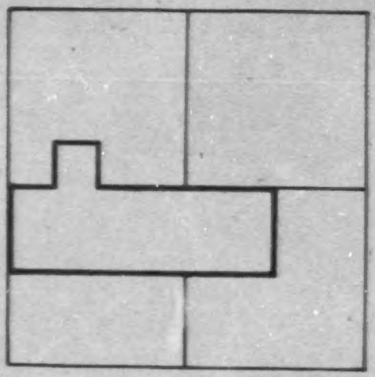
1. a. 9
   b. 13
   c. 2
   d. 10
   e. 4
   f. 3
   g. 8
   h. 6
   i. 5
   j. 12
   k. 7
   l. 11
   m. 1

2. a. Retrace old lines
   b. Locate property boundries
   c. Measure land areas not publicly surveyed

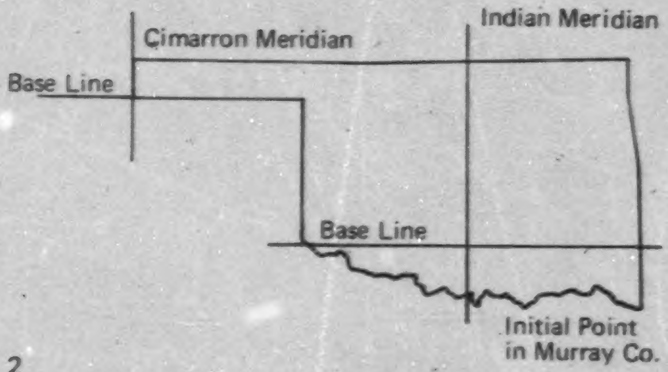
3. b, d, f

4. a. 6
   b. 10
   c. 2
   d. 9
   e. 3
   f. 7
   g. 4
   h. 1
   i. 11
   j. 8
   k. 5

5. 130 acres



6.


Cimarron Meridian
Indian Meridian
Base Line
Base Line
Initial Point
in Murray Co.

7. a. 2

   b. 1

   c. 3

8. a. 3

   b. 1

   c. 2

9. a. Bearing trees

   b. Bearing object

   c. Pits and mounds

10. Any five of the following

    a. Precise course and length of lines

    b. Kinds and diameter of bearing trees with distance and bearing

    c. Corner description

    d. Intersections with land objects

    e. Intersections with water objects

    f. Surface of the land

    g. Roads and trails

    h. Other entries of report on the character of the land, soil, water, and timber

11. a. Bureau of Land Management, Washington D.C.

    b. County courthouse in the office of county clerk, county surveyor, or some other similar county official

TREE MEASUREMENTS
UNIT III

TERMINAL OBJECTIVE

After completion of this unit the student should be able to measure tree diameters accurately according to the rules for correct measurement. He should be able to measure tree heights according to specified rules. This knowledge will be evidenced through demonstration and by scoring eighty-five percent on the unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms associated with tree measurement.
2. Name the common dendrometers used in measuring tree diameters in order of accuracy.
3. Draw a line indicating the correct location of DBH measurements when given illustrations of trees.
4. Classify tree diameters correctly into one and two inch classes when given a list of exact measurements.
5. List three tools used to obtain upper stem diameter measurement by climbing.
6. Describe the correct procedure for using the pentaprism tree caliper to obtain tree diameter.
7. Identify commonly used hypsometers.
8. Draw a diagram illustrating the principle of height measurement of the Merritt hypsometer.
9. Determine the height of trees from readings on the percent scale of the Suunto clinometer.
10. Determine the merchantable height of trees according to U.S. Forest Service tree height classification when given a drawing of trees.
11. Demonstrate the ability to:
    a. Determine diameters.
    b. Determine merchantable tree heights.

TREE MEASUREMENTS
UNIT III

SUGGESTED ACTIVITIES

I. Instructor:

  A. Provide students with objective sheet.

  B. Provide students with information and job sheets.

  C. Make transparencies.

  D. Discuss terminal and specific objectives.

  E. Discuss information sheet.

  F. Demonstrate and discuss procedures outlined in the job sheet.

  G. Arrange field trips to allow students an opportunity to complete job sheets on determining diameters and merchantable tree heights.

  H. Give test.

II. Students:

  A. Read objectives.

  B. Study information sheet.

  C. Demonstrate the ability to accomplish the procedures outlined in the job sheets.

  D. Participate in field trip.

  E. Take test.

INSTRUCTIONAL MATERIALS

I. Included in this unit:

  A. Objectives

  B. Information sheet

  C. Transparency masters

    1. TM 1–Dendrometers

    2. TM 2–DBH Measurements

    3. TM 3--Climbing Tools
    4. TM 4--Pentaprism Tree Caliper
    5. TM 5--Common Hypsometers
    6. TM 6--Merchantable Lumber

  D. Job sheets

    1. Job Sheet #1--Determine Diameters
    2. Job Sheet #2--Determine Merchantable Tree Heights

  E. Test

  F. Answers to test

II. References:

A. Avery, T. Eugene, *Forest Measurements.* New York: McGraw-Hill Book Co.

B. Forbes, Reginald D., *Forestry Handbook.* New York: Ronald Press Co.

TREE MEASUREMENTS
UNIT III

INFORMATION SHEET

I. Terms and definitions

  A. Dendrometer--A collective term for all instruments used for determining diameter

  B. DBH (Diameter Breast High)--Measured at 4 1/2 feet from the ground

  C. Tree caliper--An instrument with two prongs, one fixed and one sliding, used to obtain diameter

  D. Diameter tape--An instrument of thin steel tape graduated in units of diameter

  E. Biltmore cruiser stick--A wooden stick graduated in height units

  F. Hypsometers--A collective term for all instruments used for determining height

  G. U.S. Forest Service--A government organization responsible for the management of the national forests

  H. Bole--The tree trunk

  I. Merchantable height--Height according to specifications of an organization or industry

  J. DOB--Diameter outside the bark

II. Dendrometers used in measuring tree diameters (Transparency 1)

  (NOTE: These are listed in order of accuracy.)

  A. Caliper

  B. Diameter tape

  C. Biltmore cruiser stick

III. Rules for correct measurement of DBH (Transparency 2)

  A. Tree on slope

  B. Tree on level ground

  C. Leaning tree

INFORMATION SHEET

D. Tree forking at or above 4 1/2 feet

E. Tree forking below 4 1/2 feet

F. Tree deformed at 4 1/2 feet

G. Bottleneck tree

IV. Tree diameter classes

A. One-inch classes

1. 4.6" to 5.5" = 5"
2. 5.6" to 6.5" = 6"
3. 6.6" to 7.5" = 7"
4. 7.6" to 8.5" = 8"

B. Two-inch classes

1. 9.0" to 10.9" = 10"
2. 11.0" to 12.9" = 12"
3. 13.0" to 14.9" = 14"

V. Tools used to obtain upper stem diameter measurement by climbing (Transparency 3)

A. Gaff and harness

B. Tree ladders

C. Tree bicycles

VI. Procedure for using pentaprism tree caliper (Transparency 4)

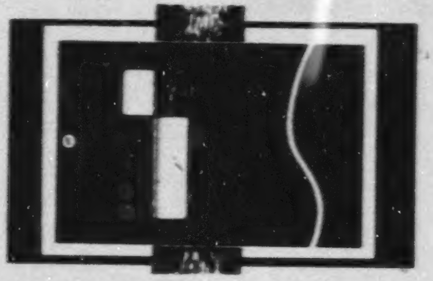
(NOTE: The range of accuracy for the pentaprism tree caliper is ten to fifty feet.)

A. Hold caliper 3 to 4 inches from eye

B. Hold pentaprism tree caliper horizontal to tree to be measured

INFORMATION SHEET

C. Slide movable pointer to obtain image below



D. Place vertical alignment between the two vertical guidelines

E. Read scale on top for diameter of tree

VII. Common hypsometers (Transparency 5)

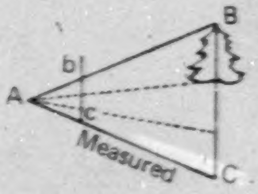
A. Merritt hypsometer on the Biltmore cruiser stick

B. Suunto clinometer

C. Haga altimeter

D. Abney hand level

VIII. Principle of height measurement with Merritt hypsometer:



Ac: AC (both set, AC paced)
BC is ready directly from intercept
bc. Any graduation–

$$bc = \frac{(Ac)\ (BC)}{AC}$$

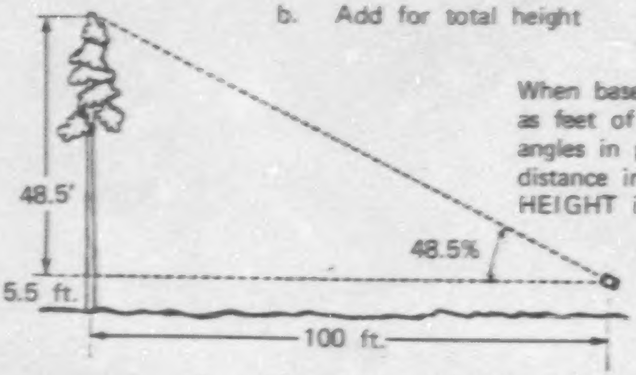
INFORMATION SHEET

IX. Determining the heights of trees using the Suunto clinometer

- A. Measure 100' distance from tree

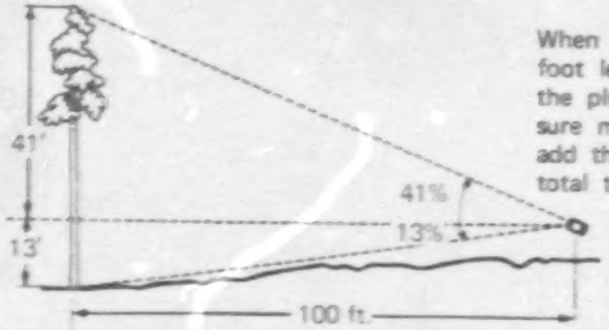
  (NOTE: A 50' distance can be used by dividing the answer in half for correct total height.)

- B. Instrument reading at the top of tree
- C. Instrument reading at the bottom of tree
- D. Procedure to follow with the above readings
  1. Tree on same level of observer
     - a. Top reading (+) with bottom reading (-)
     - b. Add for total height



When base of tree is at same level as feet of observer, measure plus angles in percent, add eye to ground distance in feet. TOTAL TREE HEIGHT is 54.0 feet.

  2. Tree below observer
     - a. Top reading (+) with bottom reading (-)
     - b Add for total height



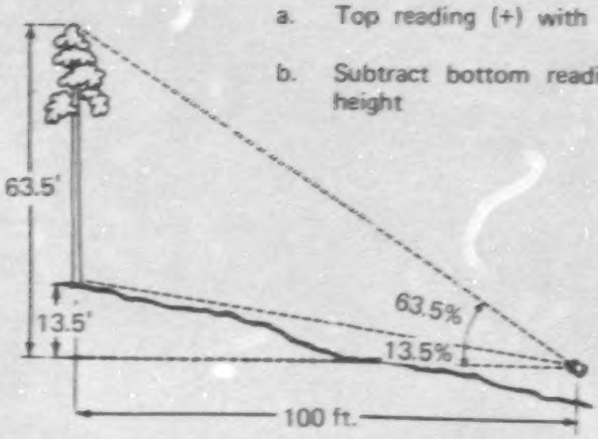
When base of tree is below the foot level of observer, measure the plus angle in percent; measure minus angle in percent, add the two and you have the total tree height IN FEET.

INFORMATION SHEET

3. Tree above observer

   a. Top reading (+) with bottom reading (+)

   b. Subtract bottom reading from the top reading for total height



When base of tree is above observer's eye level, measure total plus angle in percent, subtract from it the angle between eye level and base of tree. Remainder is tree height in percent. 63.5-13.5 = 50 feet TOTAL TREE HEIGHT.

X. U.S. Forest Service tree height classification

A. Procedure

1. Record the length to the last whole foot of the bole of all sawtimber-size live and salvable dead trees, such as softwoods 9.0 inches DBH and larger, and 11.0 inches DBH and larger for hardwoods

2. Measure from a 1-foot stump to the point above which no saw log can be produced to meet log grade standards or to a minimum top of 7.0 inches DOB for softwoods and 9.0 inches DOB for hardwoods

3. Saw log should not extend above a point where taper becomes excessive as evidenced by:

   a. A fork with less than an 8-foot saw log above it (12 feet if this is the only log in the tree)

   b. A limb with a base diameter equal to one-half or more of the stem diameter below the limb, or a group of smaller limbs with equivalent diameter which collectively influence taper to the same degree

4. Also, saw log length should not extend above a saw log section that does not meet minimum log grade specifications and which has less than 8 feet of saw log length above it

B. Description of trees (Transparency 6)

1. A sawtimber tree

   a. Saw log length terminates at 9-inch top DOB

INFORMATION SHEET

   b. Meets minimum qualifications of a 12-foot saw log

   c. Upper stem portion contains on cull and terminates at 4 inches DOB

   d. Saw log length is recorded as 12 feet; bole length as 21 feet

2. A sawtimber tree

   a. Saw log portion terminated by limbs at 13 inches DOB

   b. Contains no cull and meets minimum grade specifications

   c. Both bole length and saw log length 14 feet

   d. Portion between whorls of limbs is large enough in diameter but not in length to qualify as upper stem, such as less than 4 feet long

3. A rotten cull tree

   a. Although saw log portion is 20 feet long, a 13-foot section of rotten cull prevents utilization of a log meeting minimum grade specifications; thus whole saw log portion is culled

   b. Because more than half the volume in that portion is rotten, the tree is classed as a rotten cull tree

4. A sawtimber tree

   a. Saw log portion terminating because the branching at 15-inch top DOB meets minimum specifications

   b. Right-hand fork is too limby to qualify as upper stem, but 7 feet of left-hand fork qualifies as upper stem

5. A rough tree

   a. Saw log top terminates by branches 11 feet above crooked butt

   b. No saw log meeting minimum qualifications present

6. A sawtimber tree

   a. Despite sound cull in the saw log portion due to butt swell, a 12-foot saw log is present

   b. Seven feet of right-hand fork qualifies as upper stem

   c. Left-hand fork does not qualify due to crook

INFORMATION SHEET

7. Two sawtimber trees

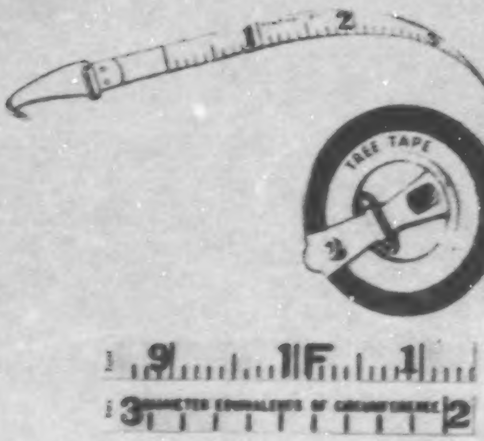
   a. Since lowest fork is below DBH, each fork is appraised and recorded as a separate tree

   b. The lower 14-foot section in the left-hand fork meets requirements for a sawtimber tree

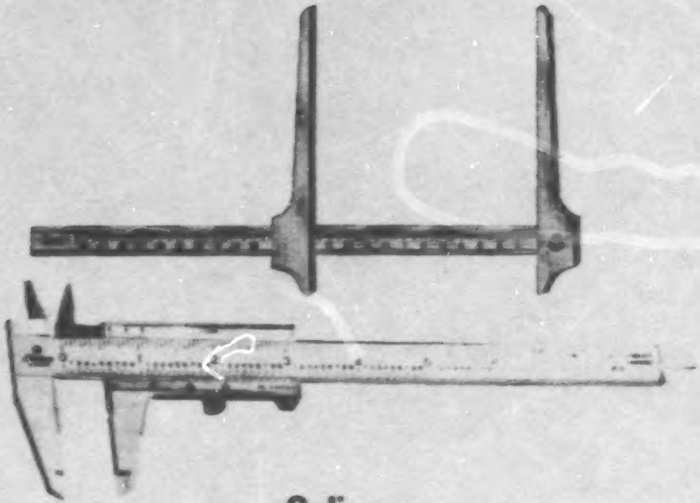
   c. A 6-foot portion of the largest stem in upper fork qualifies as upper stem material

   d. In the main right-hand fork, a 13 1/2-foot saw log plus a 9-foot saw log (with an intervening 1-foot section of sound cull) is recorded as 23 feet of saw log length; bole length is the same

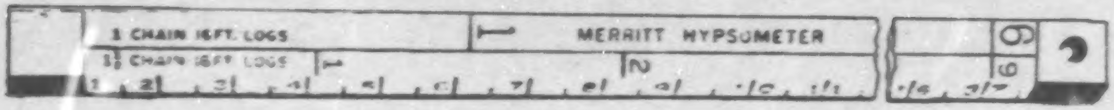
Dendrometers


TREE TAPE
DIAMETER EQUIVALENTS OF CIRCUMFERENCE

Diameter Tape

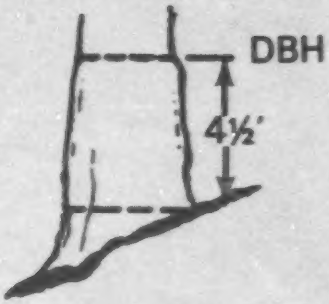


Calipers

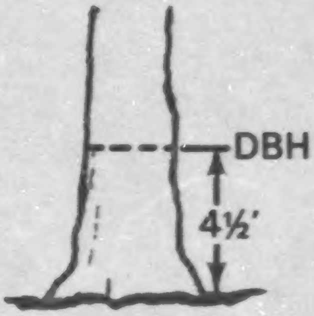

1 CHAIN 16FT. LOGS
MERRITT HYPSOMETER
1½ CHAIN 16FT. LOGS

Biltmore Cruiser Stick

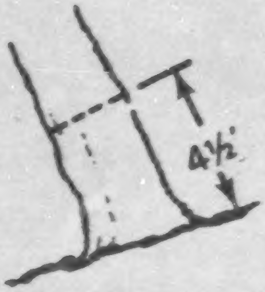
DBH Measurements



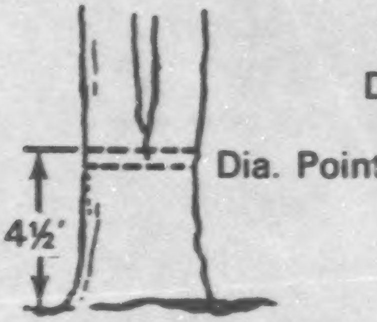
1. Tree on Slope



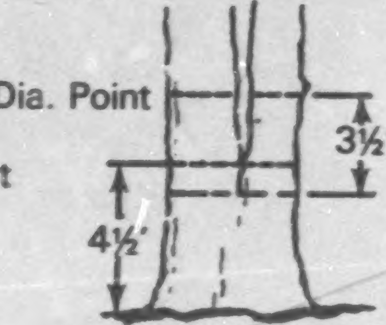
2. Tree on Level Ground



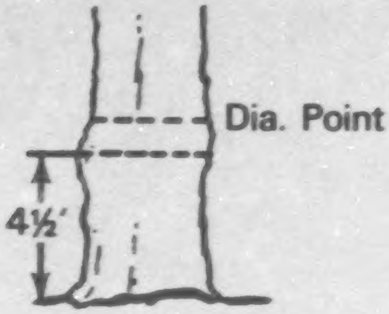
3. Leaning Tree


Dia. Point
4½'

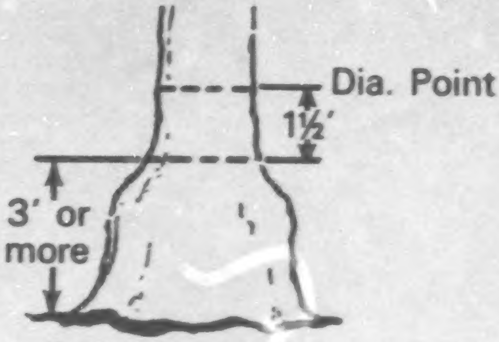
4. Tree Forking at or Above 4½ Feet


Dia. Point
3½'
4½'

5. Tree Forking Below 4½ Feet

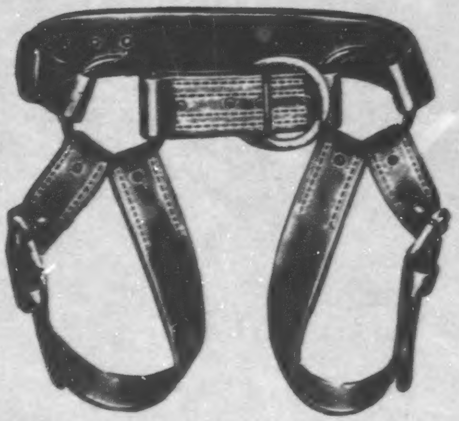

Dia. Point
4½'

6. Tree Deformed at 4½ Feet


Dia. Point
1½'
3' or more

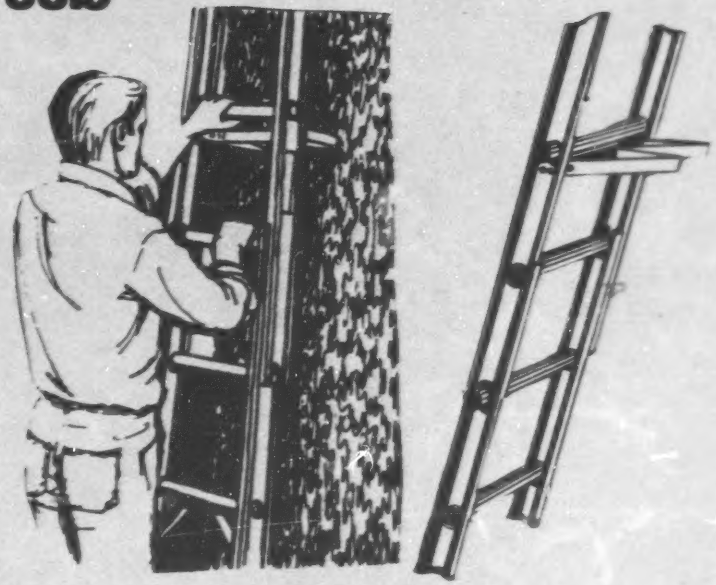
7. Bottleneck Tree

Climbing Tools

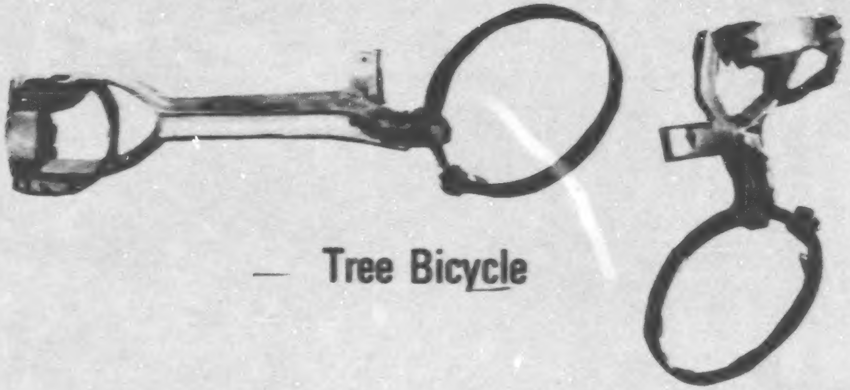


Tree Harness

Tree Gaff

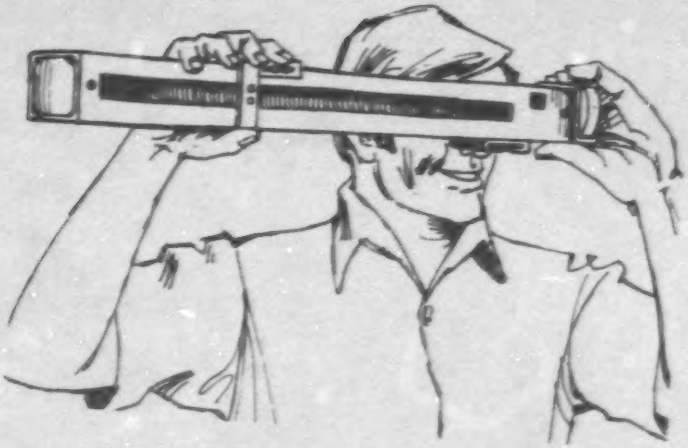


Tree Ladder



— Tree Bicycle

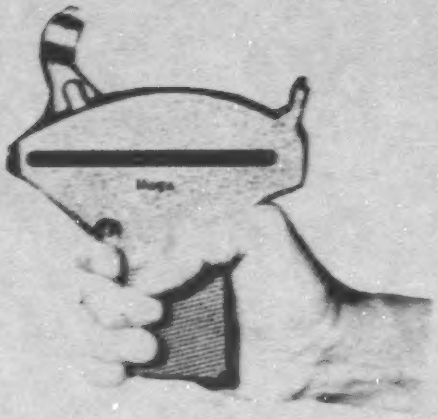
Pentaprism Tree Caliper



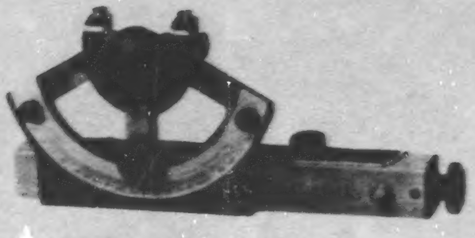
Wheeler Pentaprism Tree Caliper

TM 4

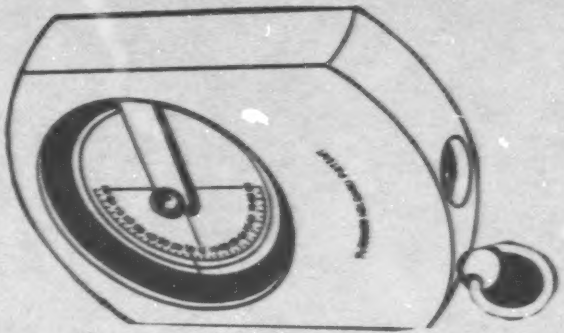
Common Hypsometers



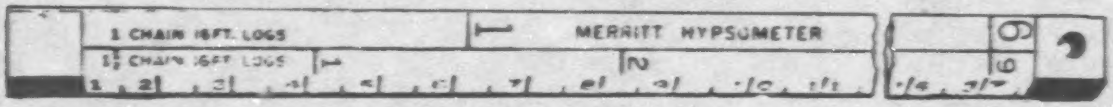
Haga Altimeter



Abney Level

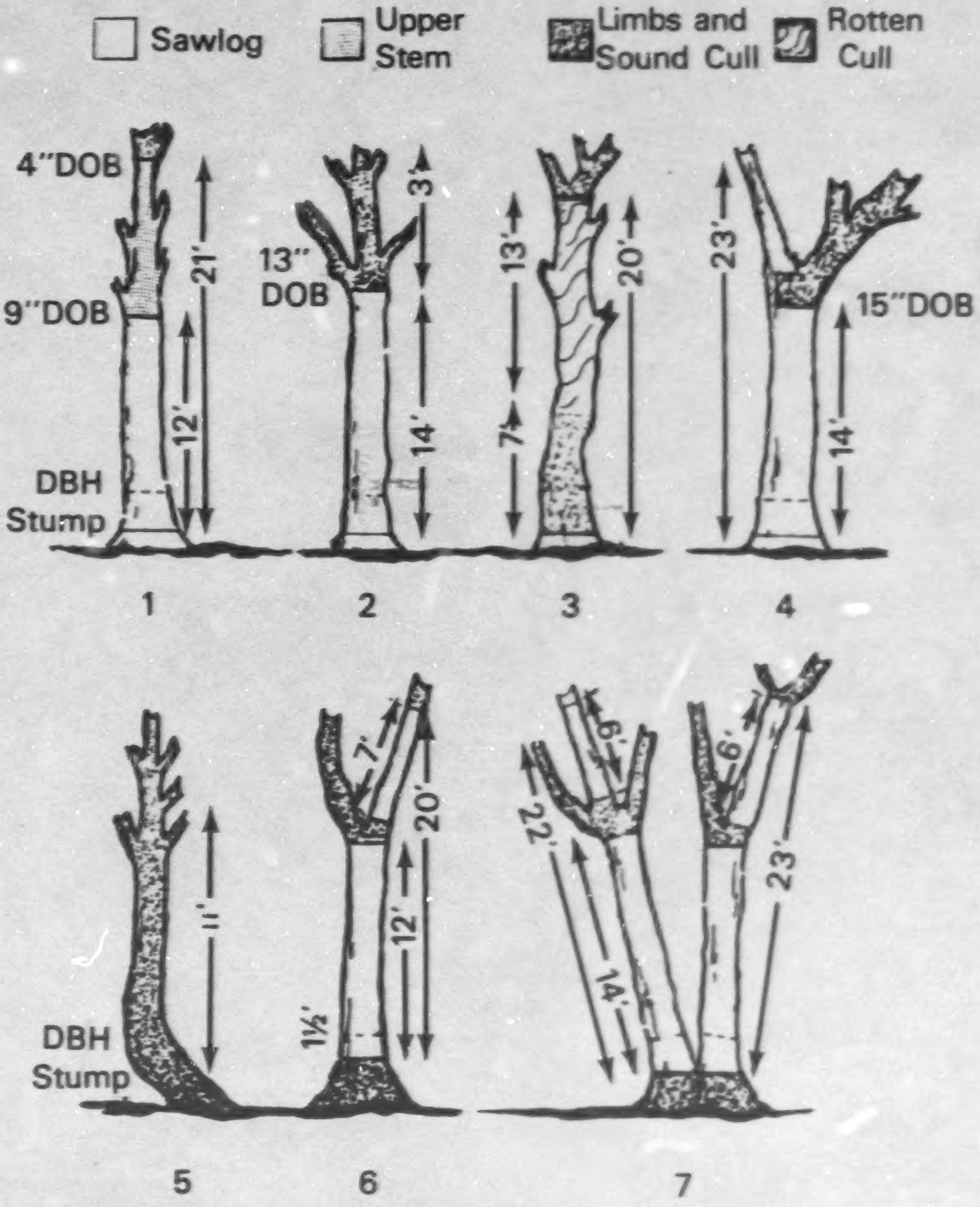


Suunto Clinometer


1 CHAIN 16FT. LOGS
MERRITT HYPSOMETER
1½ CHAIN 16FT LOGS

Merritt Hypsometer on
Biltmore Cruiser Stick

Merchantable Lumber


Sawlog
Upper Stem
Limbs and Sound Cull
Rotten Cull
4"DOB
21'
9"DOB
12'
DBH
Stump
1
3'
13" DOB
14'
2
13'
7'
20'
3
23'
15"DOB
14'
4
11'
DBH
Stump
5
7'
20'
12'
1½'
6
6'
22'
14'
6'
23'
7

TREE MEASUREMENTS
UNIT III

JOB SHEET #1--DETERMINE DIAMETERS

I. Tools and materials needed

   A. Diameter tape

   B. Selected trees

   C. Pencil

   D. Clipboard

II. Procedure

   A. Determine the diameter of 10 trees selected by the instructor

   B. Measure 4 1/2 feet on the upper slope side of the tree

   C. Find this height on your body for DBH height reference for following DBH measurements

   D. Extend the tape around the tree from the left side

   E. Grasp the hook end of tape with the right hand

   F. Pull tape taut with hands crossed over each other, left hand on top

   G. Read the tape at the point of intersection of "o" mark and diameter marks

   H. Follow the rules for correct DBH measurement

   I. Read the tape to the nearest 1/10 inch of diameter and record the measurement below

Tree No.	DBH
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

   J. Turn in to instructor for evaluation

TREE MEASUREMENTS
UNIT III

JOB SHEET #2–DETERMINE MERCHANTABLE TREE HEIGHTS

I. Tools and materials needed

A. Suunto clinometer

B. 100′ tape

C. Selected trees

D. Pencil and clipboard

II. Procedure

A. Determine the merchantable height of 10 trees selected by the instructor

B. Measure a distance of 100 feet from the tree to a point where both top and bottom of the tree can be seen

C. Estimate the point of top merchantability using these guides:

1) Minimum top of 7.0 inches outside the bark

2) A fork with less than 8 feet in either fork

3) A limb with a diameter equal to 1/2 or more the bole diameter at the point of occurrence

4) A group of limbs within a one-foot section of the bole with a total sum of diameters equal to 1/2 or more the bole diameter at the point of occurrence

D. Read the percent scale of the Suunto at the point of top merchantability

E. Read the scale at the base of the tree one foot from the ground

F. If the readings of the percent scale were on opposite sides of the scale, that is, positive and negative, add the readings together for height of the tree

G. If the readings are both positive or both negative, subtract the readings for height of the tree

JOB SHEET #2

H. Record the merchantable height of the tree below

Tree No.	Merchantable Height
1	________
2	________
3	________
4	________
5	________
6	________
7	________
8	________
9	________
10	________

I. When completed, turn in to the instructor for evaluation

TREE MEASUREMENTS
UNIT III

TEST

1. Match the terms on the right to the correct definition.

______a. A collective term for all instruments used for determining diameter

______b. Measured at 4 1/2 feet from the ground

______c. An instrument with two prongs, one fixed and one sliding, used to obtain diameter

______d. An instrument of thin steel tape graduated in units of diameter

______e. A wooden stick graduated in height units

______f. A collective term for all instruments used for determining height

______g. A government organization responsibile for the management of the national forests

______h. The tree trunk

______i. Height according to specifications of an organization or industry

______j. Diameter outside the bark

1. Tree caliper
2. Hypsometers
3. Merchantable height
4. Dendrometer
5. U.S. Forest Service
6. Diameter tape
7. Bole
8. DBH
9. Biltmore cruiser stick
10. DOB

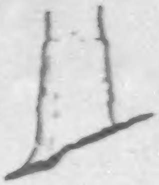
2. Name the common dendrometers used in measuring tree diameters in order of accuracy.

a.

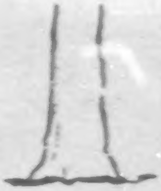
b.

c.

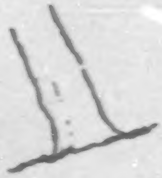
3. Draw a line indicating the correct location of DBH measurements from the illustrations given below.



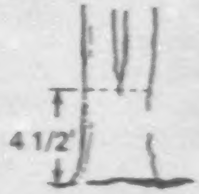
1. Tree on Slope



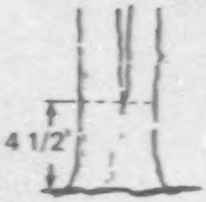
2. Tree on Level Ground



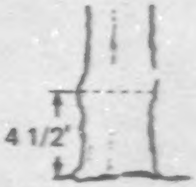
3. Leaning Tree



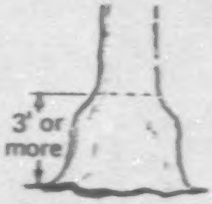
4. Tree Forking at or Above 4 1/2 Feet



5. Tree Forking Below 4 1/2 Feet



6. Tree Deformed at 4 1/2 Feet



7. Bottleneck Tree

4. Classify the following measurements of DBH into the correct diameter classes.

One-inch	Two-inch
a. 5.9"	d. 9.6"
b. 4.0"	e. 11.1"
c. 8.3"	f. 14.5"

5. List three tools used to obtain upper stem diameter measurements by climbing.

a.

b.

c.

6. Describe the correct procedure for using the pentaprism tree caliper to obtain tree diameter.

a.

b.

c.

d.

e.

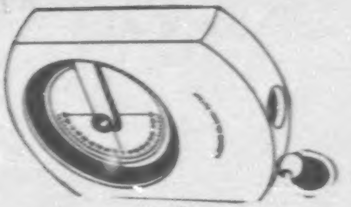
7. Identify four commonly used hypsometers.

   a.

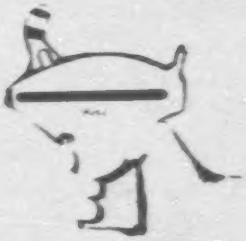
   b.

   c.

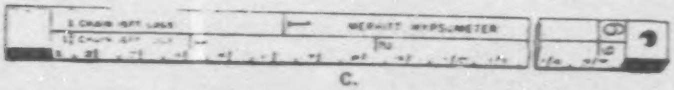
   d.



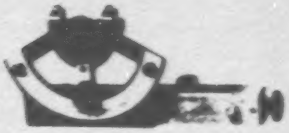
a.



b.


MERRITT HYPSOMETER

c.

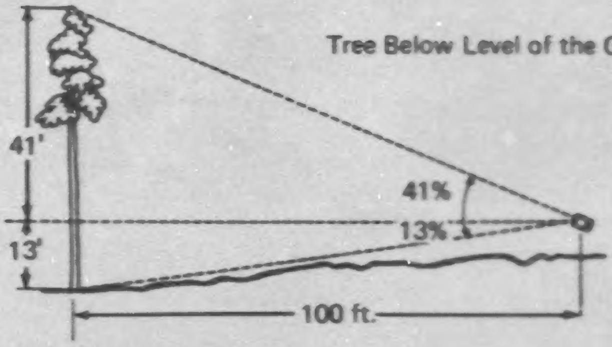


d.

8. Draw a diagram of the Merritt hypsometer principle.

9. Determine the height of these trees from the readings indicated using the Suunto clinometer.

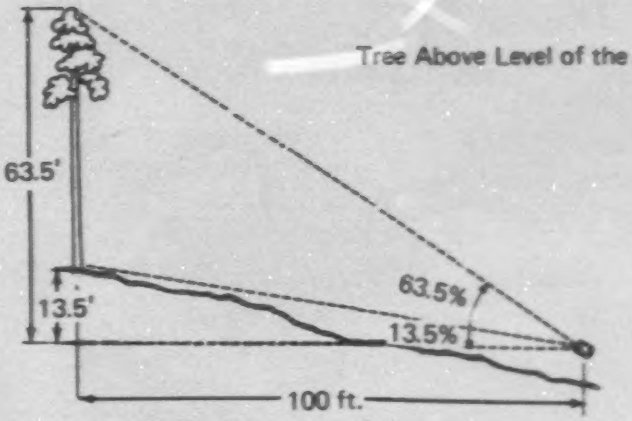
a.



Tree Below Level of the Observer

41'
41%
13%
13'
100 ft.

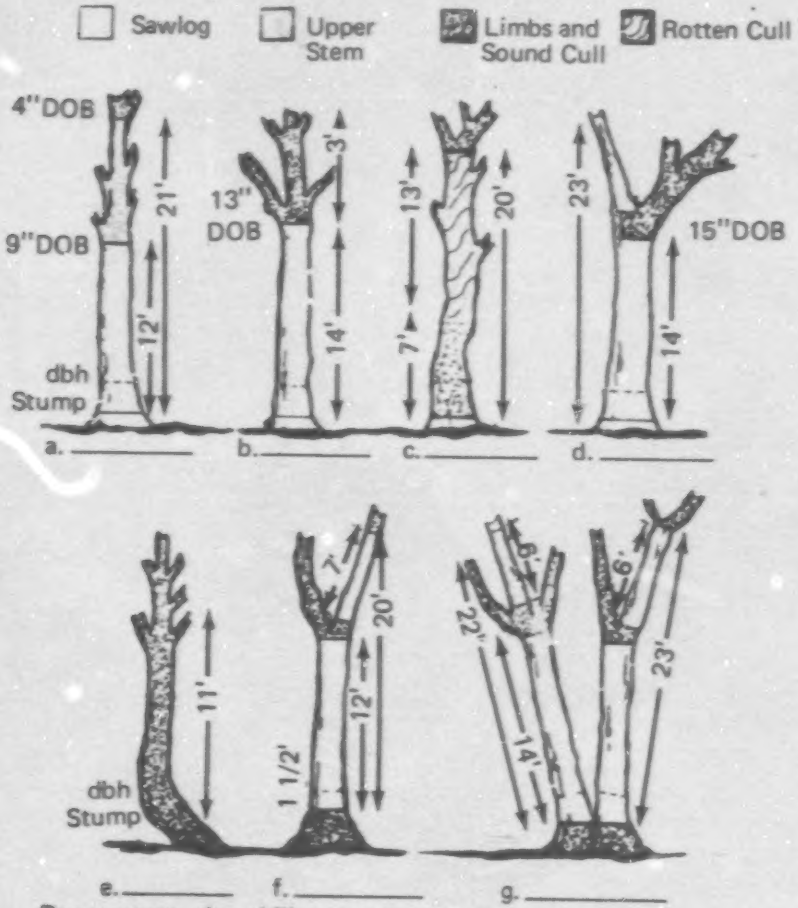
b.



Tree Above Level of the Observer

63.5'
63.5%
13.5'
13.5%
100 ft.

10. Determine the height in feet of the trees in these drawings using U.S. Forest Service merchantable heights.


Sawlog
Upper Stem
Limbs and Sound Cull
Rotten Cull
4"DOB
21'
9"DOB
12'
dbh
Stump
13" DOB
3'
14'
13'
7'
20'
23'
15"DOB
14'
a. ________
b. ________
c. ________
d. ________
11'
dbh
Stump
7'
20'
12'
1 1/2'
22'
6'
14'
6'
23'
e. ________
f. ________
g. ________

11. Demonstrate the ability to:

a. Determine diameters.

b. Determine merchantable tree heights.

(NOTE: If these have not been accomplished prior to the test, ask the instructor when the above activities should be completed.)

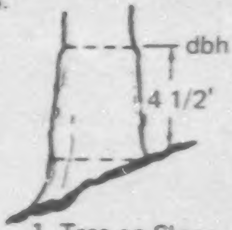
TREE MEASUREMENTS
UNIT III

ANSWERS TO TEST

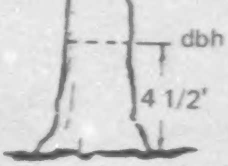
1. a. 4
   b. 8
   c. 1
   d. 6
   e. 9
   f. 2
   g. 5
   h. 7
   i. 3
   j. 10

2. a. Caliper
   b. Diameter tape
   c. Biltmore cruiser stick

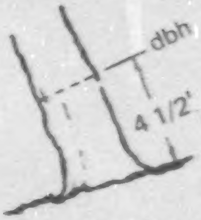
3.



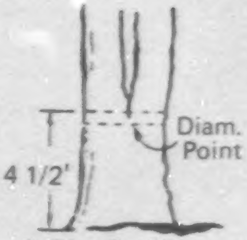
1. Tree on Slope



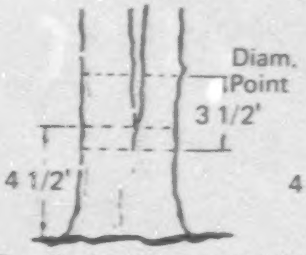
2. Tree on Level Ground



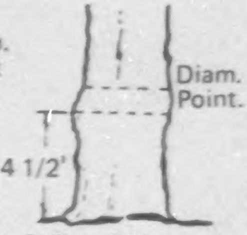
3. Leaning Tree


Diam.
Point
4 1/2'

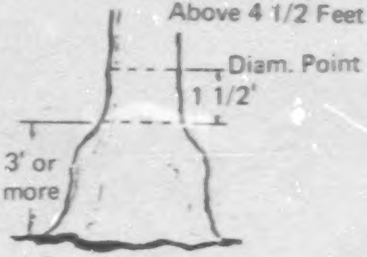
4. Tree Forking at or Above 4 1/2 Feet


Diam.
Point
3 1/2'
4 1/2'

5. Tree Forking Below 4 1/2'


Diam.
Point.
4 1/2'

6. Tree Deformed at 4 1/2 Feet


Diam. Point
1 1/2'
3' or
more

7 Bottleneck Tree

4.
   a. 6"
   b. 5"
   c. 8"
   d. 10"
   e. 12"
   f. 14"

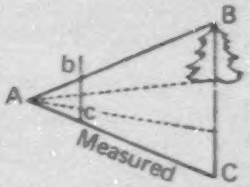
5.
   a. Gaff and harness
   b. Tree ladders
   c. Tree bicycles

6.
   a. Hold caliper 3 to 4 inches from eye
   b. Hold pentaprism tree caliper horizontal to tree to be measured
   c. Slide movable pointer to obtain correct image
   d. Place vertical alignment between the two vertical guidelines
   e. Read scale on top for diameter of tree

7.
   a. Suunto clinometer
   b. Haga altimeter
   c. Merritt hypsometer on the Biltmore cruiser stick
   d. Abney hand level

8.

Merritt



Ac: AC (both set, AC paced)
BC is ready directly from intercept
bc. Any graduation–

$$bc = \frac{(Ac)\ (BC)}{AC}$$

9.
   a. 54'
   b. 50'

10. a. 12'
    b. 14'
    c. 0
    d. 14'
    e. 0
    f. 12'
    g. 14' and 23' or 37'

11. Performance skills will be evaluated according to the satisfaction of the instructor.

LOG SCALING
UNIT IV

TERMINAL OBJECTIVE

After completion of this unit, the student should be able to scale downed logs to obtain net volume. He should be able to recognize scale defects and deduct appropriate reductions of volume. This knowledge will be evidenced through demonstration and by scoring eighty-five percent on the unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms associated with log scaling to the correct definition.
2. List in order of accuracy, the commonly used log rules in the South.
3. List the three parts of a scale stick.
4. List the five steps in the procedure of log scaling.
5. List kinds of defects for each of the four classes of defects given.
6. Write the formulas for the five types of defect deductions.
7. Determine scaling deduction for the five types of defect deductions.
8. Demonstrate the ability to:
    a. Identify types of defects.
    b. Scale net volume of logs.

LOG SCALING
UNIT IV

SUGGESTED ACTIVITIES

I. Instructor:

  A. Provide students with objective sheet.

  B. Provide students with information, assignment, and job sheets.

  C. Make transparencies.

  D. Discuss terminal and specific objectives.

  E. Discuss information and assignment sheets.

  F. Demonstrate and discuss procedures outlined in the job sheets.

  G. Arrange field trips to allow students an opportunity to practice identifying types of defects and scaling logs.

  H. Give test.

II. Students:

  A. Read objectives.

  B. Study information sheet.

  C. Demonstrate the ability to accomplish the procedures outlined in the job sheets.

  D. Participate in field trip.

  E. Take test.

INSTRUCTIONAL MATERIALS

I. Included in this unit:

  A. Objectives

  B. Information sheet

  C. Transparency master: TM 1–Parts of a Scale Stick

  D. Assignment Sheet #1–Determine Scaling Deduction

E. Answers to Assignment Sheet

F. Job sheets

  1. Job Sheet #1–Identify Types of Defects

  2. Job Sheet #2–Scale Net Volume of Logs

G. Test

H. Answers to test

II. References

A. Avery, T. Eugene. *Forest Measurements.* New York: McGraw-Hill Book, Co.

B. NE Forest Experiment Station. *Hardwood Log Grading.* Upper Darby, Pennsylvania: USDA Forest Service.

LOG SCALING
UNIT IV

INFORMATION SHEET

I. Terms and definitions

   A. Log scaling--The art of estimating volume of downed logs

   B. Log rule--A table showing the volume of straight, sound logs of various lengths and diameters

   C. Scale stick--A rule of inches with log volumes for varying lengths

   D. Scaling diameter--Average diameter of the small end of the log

   E. Volume--Board-foot content

   (NOTE: This refers also to cubic feet, cords of pulpwood, and other commonly used volume measurements.)

   F. Scale defect--An imperfection that would reduce the volume

   (NOTE: Any defect that would reduce the volume of sawn boards is a scale defect, and those defects that reduce the quality of sawn boards is a grade defect.)

   G. Net volume--The scale of sound volume after deduction of defect

   H. Heartrot--Decay of the heartwood

   I. Ring shake--Separation of the rings

   J. Checks--Splitting of the wood around the exterior

   K. Catface--A fire scar or other damage on the side of the log

   L. Brooming--The pulling and separation of wood from the core of the log; wood strips left on the stump

   M. Sweep--A scaling defect consisting of a curve in a log that extends its full length

   N. Hollow--Generally an interior defect due to rotten or decayed wood

   O. Cruising--A forest estimation by sampling

INFORMATION SHEET

II. Log rules used in the South

(NOTE: These are listed according to accuracy.)

- A. International 1/4"
- B. Scribner decimal C
- C. Doyle

III. Parts of scale stick (Transparency 1)

- A. Scaling diameter
- B. Length
- C. Volume

IV. Procedures for scaling

- A. Find and measure scaling diameter
- B. Measure to length class

  (NOTE: Three inches of trim are needed. Drop back to lower length class if three inches are not available.)
- C. Record volume from scale stick
- D. Determine scale defect and percent loss
- E. Record net volume

V. Classes and kind of defects

- A. Interior
  1. Heartrot
  2. Hollow
  3. Ring shake
- B. Exterior
  1. Sap rot
  2. Checks
  3. Catface

INFORMATION SHEET

C. Crook

  1. Sweeps
  2. Crook
  3. Forked

D. Operating

  1. Breakage
  2. Splits
  3. Brooming

VI. Defect deductions

A. Defect section

$$\frac{\text{length of defective section}}{\text{length of log}} = \text{cull percent}$$

B. Defect sector

$$\frac{\text{length of defective section}}{\text{length of log}} \times \frac{\text{angle of defect}}{360^\circ} = \text{cull percent}$$

C. Sweep

$$\frac{\text{maximum departure minus } 2''}{\text{scaling diameter}} = \text{cull percent}$$

D. Crook

$$\frac{\text{length of deflecting section}}{\text{length of log}} \times \frac{\text{maximum deflection}}{\text{scaling diameter}} = \text{cull percent}$$

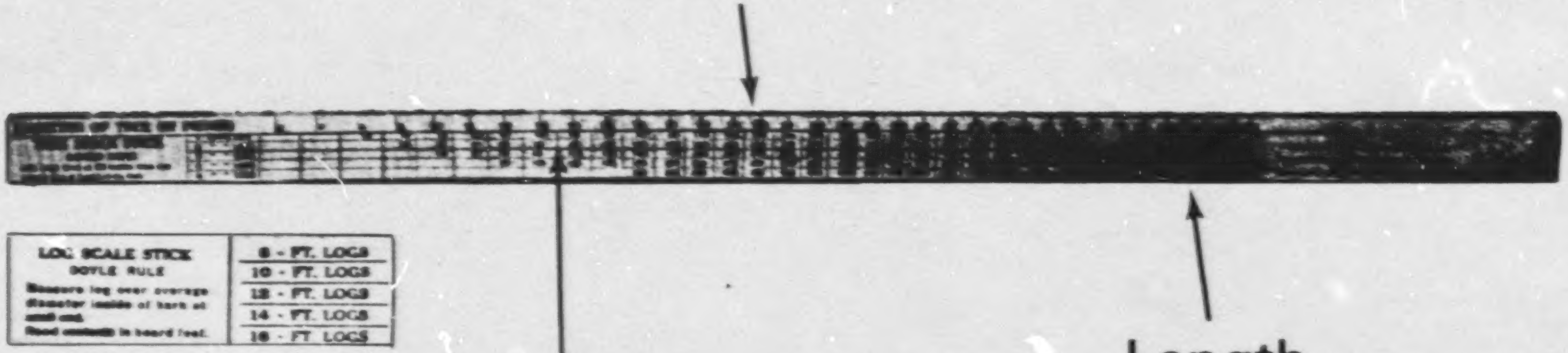
E. Interior defect

$$\frac{(\text{major defect diameter})\ (\text{minor defect diameter})}{(\text{scaling diameter} - 1)^2} \times$$

$$\frac{\text{length of defect}}{\text{length of log}} = \text{cull percent}$$

In practice each ellipse axis can be divided by (20-1) and rounded to nearest tenth if desired.

Parts of a Scale Stick


LOG SCALE STICK
DOYLE RULE
Measure log over average diameter inside of bark at small end.
Read contents in board feet.
8 - FT. LOGS
10 - FT. LOGS
12 - FT. LOGS
14 - FT. LOGS
16 - FT. LOGS

Scaling Diameter

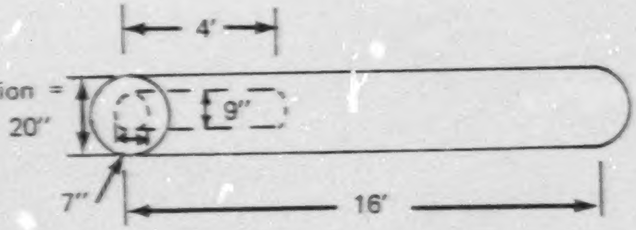
Volume

Length

ASSIGNMENT SHEET #1

5. Interior defect

Percent deduction =



Taken from: Aids for determining scaling deductions. From: Grosenbaugh, L.R., *Short Cuts for Cruisers and Scalers;* U.S. Forest Serv. South. Forest Expt. Sta. Occas. Paper 126, 1952.

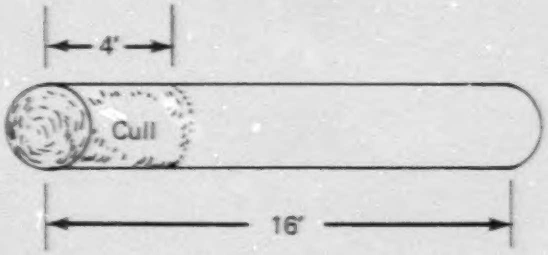
LOG SCALING
UNIT IV

ASSIGNMENT SHEET #1--DETERMINE SCALING DEDUCTION

Determine the scaling deduction for the five types of defects based on a sixteen foot log with a twenty inch scaling diameter.

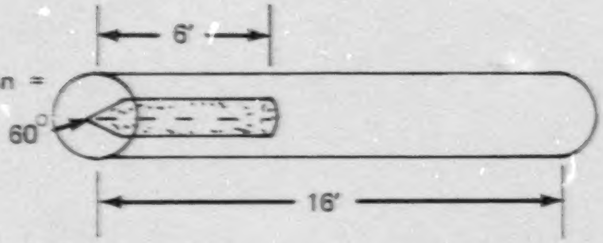
1. Defect section

Percent deduction =



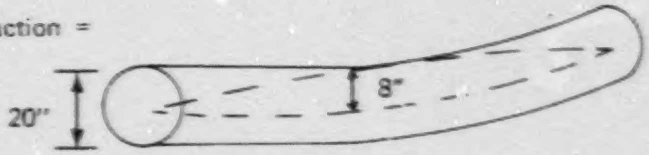
2. Defect sector

Percent deduction =



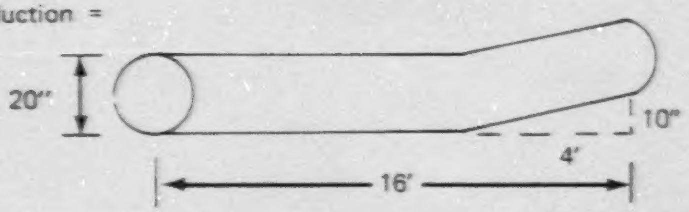
3. Sweep

Percent deduction =



4. Crook

Percent deduction =



LOG SCALING
UNIT IV

ANSWERS TO ASSIGNMENT SHEET

1. $\frac{4}{16} = 25\%$

2. $(\frac{6}{16})(\frac{60}{360}) = 6\ 1/4\%$

3. $\frac{8-2}{20} = 30\%$

4. $(\frac{10}{20})(\frac{4}{16}) = 12\ 1/2\%$

5. $\frac{(8)\ (10)}{20-1^2}\ (\frac{4}{16}) = 5\ 5/9\%$

   In practice each ellipse axis can be divided by (20-1) and rounded to nearest tenth if desired.

   Thus $\frac{8}{19} = .4$, $\frac{10}{19} = .5$, and $(.4)\ (.5)\ (\frac{4}{16}) = 5\%$

LOG SCALING
UNIT IV

JOB SHEET #1–IDENTIFY TYPES OF DEFECTS

I. Tools and materials needed

   A. Scale stick

   B. Hatchet

   C. Logs indicated by instructor

   D. Clipboard and pencil

II. Procedure

   A. Identify the types of defects in logs indicated by instructor

   B. Examine both end and surface features of each log

   C. Indicate type of defect

   D. Place an X in the correct space provided

   E. When completed, turn in to instructor for evaluation

Defects

Log No.	Interior	Exterior	Crooks	Operating
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

LOG SCALING
UNIT IV

JOB SHEET #2–SCALE NET VOLUME OF LOGS

I. Tools and materials needed

   A. Scale stick (Doyle Rule)

   B. Hatchet

   C. Logs indicated by instructor

   D. Clipboard, pencil, and scale tally form

II. Procedure

   A. Find and measure scaling diameter

   B. Measure to length class

   C. Record volume from scale stick

   D. Determine scale defect and percent loss

   E. Record net volume

   F. Complete the form on the following page

   G. When completed, turn in to instructor for evaluation

JOB SHEET #2

SCALE TALLY

Location ______________________ Scaler ______________________

Species ______________________ Date ______________________

Log Rule ______________________

Log No.	Length (ft.)	D.i.b. Small End	Gross Volume Bd. Ft.	Defect			Net Volume Bd. Ft.
				Type	Dimension	Volume	
Totals							

LOG SCALING
UNIT IV

TEST

1. Match the terms on the right to the correct definition.

______a. The art of estimating volume of downed logs

______b. A table showing the volume of straight, sound logs of various lengths and diameters

______c. A rule of inches with log volumes for varying lengths

______d. Average diameter of the small end of the log

______e. Board-foot content

______f. An imperfection that would reduce the volume

______g. The scale of, sound volume after deduction of defect

______h. Decay of the heartwood

______i. Separation of the rings

______j. Splitting of the wood around the exterior

______k. A fire scar or other damage on the side of the log

______l. The pulling and separation of wood from the core of the log; wood strips left on the stump

______m. A scaling defect consisting of a curve in a log that extends its full length

______n. A forest estimation by sampling

______o. Generally an interior defect due to rotten or decayed wood

1. Scaling diameter
2. Heartrot
3. Scale defect
4. Checks
5. Scale stick
6. Brooming
7. Net volume
8. Catface
9. Log scaling
10. Ring shake
11. Volume
12. Log rule
13. Sweep
14. Hollow
15. Cruising

2. List in order of accuracy, the commonly used log rules in the South.

   a.

   b.

   c.

3. List the three parts of a scale stick.

   a.

   b.

   c.

4. List the five steps in the procedure of log scaling.

   a.

   b.

   c.

   d.

   e.

5. List one kind of defect for each of the following classes of defects.

   a. Interior

   b. Exterior

   c. Crook

   d. Operating

6. Write the formulas for the following percent defect deductions of logs.

   a. Defect section

   b. Defect sector

   c. Sweep

   d. Crook

   e. Interior defect

7. Determine scaling deduction for the five types of defect deductions.

   (NOTE: If this has not been accomplished prior to the test, ask the instructor when the above activity should be completed.)

8. Demonstrate the ability to

   a. Identify type of defects.

   b. Scale net volume of logs.

   (NOTE: If these have not been accomplished prior to this test, ask the instructor when the above activities should be completed.)

LOG SCALING
UNIT IV

ANSWERS TO TEST

1. a. 9
   b. 12
   c. 5
   d. 1
   e. 11
   f. 3
   g. 7
   h. 2
   i. 10
   j. 4
   k. 8
   l. 6
   m. 13
   n. 15
   o. 14

2. a. International 1/4"
   b. Scribner decimal C
   c. Doyle

3. a. Scaling diameter
   b. Length
   c. Volume

4. a. Find and measure scaling diameter
   b. Measure to length class
   c. Record volume from scale stick
   d. Determine scale defect and percent loss
   e. Record net volume

5. Any one of the following for each defect
   a. Heartrot, hollow, or ring shake
   b. Sap rot, checks, or catface
   c. Sweeps, crooks, or forked
   d. Breakage, splits, or brooming

6. a. $\frac{\text{length of defective section}}{\text{length of log}}$ = cull percent

   b. $\frac{\text{length of defective section}}{\text{length of log}} \times \frac{\text{angle of defect}}{360^\circ}$ = cull percent

   c. $\frac{\text{maximum departure minus 2"}}{\text{scaling diameter}}$ = cull percent

   d. $\frac{\text{length of deflecting section}}{\text{length of log}} \times \frac{\text{maximum deflection}}{\text{scaling diameter}}$ = cull percent

   e. $\frac{\text{(major defect diameter) (minor defect diameter)}}{(\text{scaling diameter} - 1)^2} \times \frac{\text{length of defect}}{\text{length of log}}$ =

   cull percent

7. Evaluated to the satisfaction of the instructor.

8. Performance skills will be evaluated to the satisfaction of the instructor.

PINE TREE GRADING
UNIT V

TERMINAL OBJECTIVE

After completion of this unit, the student should be able to grade southern pine trees. He should be able to measure log heights and upper stem diameters. This knowledge will be evidenced by demonstration and by scoring eighty-five percent on the unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms associated with pine tree grading to the correct definition.
2. Choose from a list two reasons pine trees are graded.
3. Arrange in order the procedure to find the height of trees in logs.
4. List three common tools used to obtain upper stem diameters.
5. List the procedure to establish tentative log grades.
6. List the three defects that degrade the tentative grade to a final grade.
7. Demonstrate the ability to:
    a. Measure log heights.
    b. Measure upper stem diameters.
    c. Grade pine trees.

PINE TREE GRADING
UNIT V

SUGGESTED ACTIVITIES

I. Instructor:

  A. Provide students with objective sheet.

  B. Provide students with information and job sheets.

  C. Discuss terminal and specific objectives.

  D. Discuss information sheet.

  E. Demonstrate and discuss procedures outlined in the job sheets.

  F. Arrange field trips to allow students an opportunity to practice measuring log heights, measuring upper stem diameter, and grading pine trees.

  G. Give test.

II. Students:

  A. Read objectives.

  B. Study information sheets.

  C. Demonstrate the ability to accomplish the procedures outlined in the job sheets.

  D. Participate in field trip.

  E. Take test.

INSTRUCTIONAL MATERIALS

I. Included in this unit:

  A. Objectives

  B. Information sheet

  C. Job sheets

    1. Job Sheet #1--Measure Log Heights

    2. Job Sheet #2--Measure Upper Stem Diameter

    3. Job Sheet #3--Grade Pine Trees

D. Test

E. Answers to test

II. Reference--Southern Forest Experiment Station. *Grading Southern Pine.* Asheville, North Carolina: USDA Forest Service.

PINE TREE GRADING
UNIT V

INFORMATION SHEET

I. Terms and definitions

A. Grading--The judging of logs and trees into specific classes based on quality of products

B. Upper stem diameter--Any diameter on a tree above DBH

C. Spiegel relaskop--A versatile instrument used to find diameters, heights, basal area, and feet rise in 100' or 66'

D. Scaling diameter--The small end or top end of the log

E. Log--Any tree section between 8' and 20' long (plus trim), measuring at least 4 1/2" in diameter at the small end

F. Log face--A portion of the log surface equal to 1/4 the circumference extending the full length of the log

(NOTE: Each log has four faces.)

G. Quarter face--A portion of the log surface euqal to 1/4 the circumference extending 1/4 the log length; a quarter-face area can be outlined anywhere on a log

H. D--Average diameter at small end of log inside bark to nearest whole inch--usually called "scaling diameter"

I. Log knot--Any visible branch, stub, or socket over 1/2" in average diameter, or evidence thereof

(NOTE: Diameter of log knots is measured to the nearest average whole inch, outside bark at junction of limb with collar or to the outside limb growth ring if limb is cut flush with log surface.)

J. Sound--Any log knot which does not contain advance decay or does not contain a hole larger than 1/4" in diameter and extending into the log 2 or more inches

K. Unsound--Any log knot containing advance decay or a hole larger than 1/4" in diameter and 2 or more inches deep

L. Overgrown--Any log knot buried below the bark surface but indicated by a disturbance of the bark pattern

M. Oversize--Any sound log knot with diameter larger than D/6

INFORMATION SHEET

N. K count--A numerical log knot factor used in association with log diameter for placing a log in its tentative grade

(NOTE: It is the number of visible overgrown log knots, plus the sum of average diameters of sound log knots, plus twice the sum of the average diameters of unsound log knots.)

O. Sweep--The general deviation of the longitudinal log axis from a straight line connecting geometric centers of the log ends

(NOTE: It is measured to the nearest whole inch at the point of greatest deviation. Sweep must measure 3" and equal or exceed D/3 to constitute a defect.)

P. Conk--A fruiting body of a fungus

Q. Hyphae--The vegetative body of a fungus

II. Reasons for grading pine trees

A. Separate logs and trees into product manufacture class

B. Determine the relative qualities of products possible

III. Procedure for measuring log heights

A. Measure out 50' from tree

B. Shoot base of tree with suunto or abney

C. Subtract reading from 34.6

D. Set suunto or abney at the answer of above

E. Sight on tree = 17.3' (the top of first log)

F. Repeat for each log in tree

(NOTE: For each log, the height reading increases 34.6.)

IV. Common tools used for upper stem diameters

A. Estimation

B. Wheeler pentaprism

C. Speigel relaskop

INFORMATION SHEET

V. Tentative grade procedure

A. Divide tree into log sections

B. Determine scaling diameters of logs

C. Determine (K) count

Example:

Grade	Minimum scaling diameter (D) (inches)	Maximum knot count (K)
1	17	D/5
2	10	D/2
3	5	no limit
4	5	no limit

VI. Final grade defect sequence

A. Sweep--Degrade any tentative 1, 2, or 3 grade log one grade if sweep is at least 3 inches and equals or exceeds D/3

(NOTE: This is the final grade if the log has no evidence of heart rot and no unsound or oversize knots.)

B. Heart rot--Degrade any tentative 1, 2, or 3 grade log one grade if conk, massed hyphae, or other evidence of advance heart rot is found

(NOTE: This is the final grade if log has no unsound or oversize knots.)

C. Unsound or oversize knots--Degrade any tentative grade 3 log to grade 4 if unsound or oversize log knots are dispersed so that they cannot be contained in one quarter face

Example:

INFORMATION SHEET

4-FACE GRADING

D.i.b. small end	Log grade No.			Degrading (G3 to G4 in not if 1/4 face)	
	1	2	3	Sweep (Maximum)	Bad knot (Unsound or oversize)
Inches	Limits of K			Inches	Inches
	$\frac{dib}{5}$	$\frac{dib}{2}$	unlimited	or $\frac{dib}{3}$	
5			0+	3	1
6			0-	3	2
7			0-	3	2
8			0-	3	2
9			0-	3	2
10		0-5	6-	4	2
11		0-5	6-	4	2
12		0-6	7-	4	3
13		0-6	7-	5	3
14		0-7	8-	5	3
15		0-7	8-	5	3
16		0-8	9-	6	3
17	0-3	4-8	9-	6	3
18	0-3	4-9	10-	6	4
19	0-3	4-9	10-	7	4
20	0-4	5-10	11-	7	4
21	0-4	5-10	11-	7	4
22	0-4	5-11	12-	8	4
23	0-4	5-11	12-	8	4
24	0-4	5-12	13-	8	5
25	0-5	6-12	13-	8	5
26	0-5	6-13	14-	9	5
27	0-5	6-13	14-	9	5
28	0-5	6-14	15-	10	5
29	0-5	6-14	15-	10	5
30	0-6	7-15	16-	10	6

(NOTE: For heart rot, degrade minus one grade.)

FACTOR K. - Number of overgrown knots, plus the sum of diameters of sound exposed knots, plus twice the sum of diameters of unsound knots. Diameters to nearest whole inch at point of trimming.

PINE TREE GRADING
UNIT V

JOB SHEET #1–MEASURE LOG HEIGHTS

Measure log heights using a suunto clinometer and the procedures given. When completed, turn in to the instructor for evaluation.

I. Tools and materials needed

   A. Suunto Clinometer

   B. 50 foot tape

   C. Tree, indicated by the instructor

   D. Clipboard, paper, and pencil

II. Procedure

   A. Measure out 5' from tree

   B. Shoot base of tree with suunto or abney

   C. Subtract reading from 34.6

   D. Set suunto or abney at the answer of above

   E. Sight on tree = 17.3' (the top of first log)

   F. Repeat for each log in tree

   (NOTE: For each log, the height reading increases 34.6.)

   G. Record an "X" in the space below for the number of 16' logs determined

Tree No.	16'	32'	48'	64'
1				
2				
3				
4				
5				

PINE TREE GRADING
UNIT V

JOB SHEET #2–MEASURE UPPER STEM DIAMETERS

Measure upper stem diameters using a wheeler pentaprism and the procedure given. When completed, turn in to the instructor for evaluation.

I. Tools and materials needed

   A. Wheeler pentaprism

   B. Diameter tape

   C. Suunto clinometer

   D. 50' tape

   E. Clipboard and pencil

   F. Attached example of use of wheeler pentaprism

   G. Trees indicated by instructor

II. Procedure

   A. Using the attached example–practice measuring trees at DBH

   B. Check measurements with diameter tape

   C. Measure out 50' from tree

   D. Shoot base of tree with suunto or abney

   E. Subtract reading from 34.6

   F. Set suunto or abney at the above answer

   G. Sight on tree = 17.3' (the top of the first log)

   H. Repeat for each log in tree

   (NOTE: For each log, the height increases 34.6.)

   I. Fill in the correct diameter measurement below:

Tree No.	Diameter at 17.3'
1	________________
2	________________
3	________________
4	________________
5	

PINE TREE GRADING
UNIT V

JOB SHEET #3–GRADE PINE TREES

Grade pine trees using the procedure given. When completed, turn in to the instructor for evaluation.

I. Tools and materials needed

   A. Suunto clinometer

   B. Wheeler pentaprism

   C. 50' tape

   D. Clipboard and pencil

   E. Attached 4-face grading table

II. Procedure

   A. Divide tree into log sections

   B. Determine scaling diameter of logs

   C. Determine (K) count

   Example:

Grade	Minimum scaling diameter (D) (inches)	Maximum knot count (K)
1	17	D/5
2	10	D/2
3	5	no limit
4	5	no limit

   D. For sweep, degrade any tentative 1, 2, or 3 grade log one grade if sweep is at least 3 inches and equals or exceeds D/3

   (NOTE: This is the final grade if the log has no evidence of heart rot and no unsound or oversize knots.)

   E. For heart rot, degrade any tentative 1, 2, or 3 grade log one grade if conk, marred hyphae or other evidence of advance heart rot is found

   (NOTE: This is the final grade if log has no unsound or oversize knots.)

JOB SHEET #3

F. For unsound or oversize knots, degrade any tentative grade 3 log to grade 4 if unsound or oversize log knots are dispersed so that they cannot be contained in one quarter face

G. Fill in the appropriate information below for the first 16' log of each tree

Tree No.	Scaling Diameter	K Count	Tentative Grade	Degrade Defect	Final Grade
1					
2					
3					
4					
5					

PINE TREE GRADING
UNIT V

TEST

1. Match the terms on the right to the correct definition.

_____a. The judging of logs and trees into specific classes based on quality of products

_____b. Any diameter on a tree above DBH

_____c. A versatile instrument used to find diameters, heights, basal area, and feet rise in 100' or 66'

_____d. The small end or top end of the log

_____e. Any tree section between 8' and 20' long (plus trim), measuring at least 4 1/2" in diameter at the small end

_____f. A portion of the log surface equal to 1/4 the circumference extending full length of the log

_____g. A portion of the log surface equal to 1/4 the circumference extending 1/4 the log length; a quarter-face area can be outlined anywhere on a log

_____h. Average diameter at small end of log inside bark to nearest whole inch--usually called "scaling diameter"

_____i. Any visible branch, stub, or socket over 1/2" in average diameter, or evidence thereof

_____j. Any log knot which does not contain advance decay or does not contain a hole larger than 1/4" in diameter and extending into the log 2 or more inches

1. Sound
2. Overgrown
3. D
4. K count
5. Upper stem diameter
6. Hyphae
7. Log face
8. Oversize
9. Grading
10. Conk
11. Log knot
12. Sweep
13. Scaling diameter
14. Quarter face
15. Spiegel relaskop
16. Unsound
17. Log

_____k. Any log knot containing advance decay or a hole larger than 1/4" in diameter and 2 or more inches deep

_____l. Any log knot buried below the bark surface but indicated by a disturbance of the bark pattern

_____m. Any sound log knot with diameter larger than D/6

_____n. A numerical log knot factor used in association with log diameter for placing a log in its tentative grade

_____o. The general deviation of the longitudinal log axis from a straight line connecting geometric centers of the log ends

_____p. A fruiting body of a fungus

_____q. The vegetative body of a fungus

2. Choose from this list the two reasons pine trees are graded.

_____a. To determine volume of boards

_____b. To separate logs and trees into product manufacture class

_____c. To determine the relative qualities of products possible

_____d. To estimate the number of sizes of trees

3. Arrange in order the procedure to find the height of trees in logs.

_____a. Sight on tree = 17.3' (the top of first log)

_____b. Repeat for each log in tree

_____c. Shoot base of tree with suunto or abney

_____d. Subtract reading from 34.6

_____e. Measure out 50' from tree

_____f. Set suunto or abney at the answer of above

4. List the three common tools used to obtain upper stem diameters.

a.

b.

c.

5. List the steps taken to establish tentative log grades using this table.

Grade	Minimum scaling diameter (D) (inches)	Maximum knot count (K)
1	17	D/5
2	10	D/2
3	5	no limit
4	5	no limit

a.

b.

c.

6. List the three defects that degrade a tentative grade to a final grade.

a.

b.

c.

7. Demonstrate the ability to:

a. Measure log heights.

b. Measure upper stem diameter.

c. Grade pine trees.

(NOTE: If this has not been accomplished prior to the test, ask the instructor when the above activities should be completed.)

PINE TREE GRADING
UNIT V

ANSWERS TO TEST

1.	a.	9
	b.	5
	c.	15
	d.	13
	e.	17
	f.	7
	g.	14
	h.	3
	i.	11
	j.	1
	k.	16
	l.	2
	m.	8
	n.	4
	o.	12
	p.	10
	q.	6
2.	b	
	c	
3.	a.	5
	b.	6
	c.	2
	d.	3

e. 1

f. 4

4. a. Estimation

   b. Wheeler pentaprism

   c. Speigel relaskop

5. a. Divide tree into log sections

   b. Determine scaling diameters of logs

   c. Determine (K) count

6. a. Sweep

   b. Heart rot

   c. Unsound or oversize knots

7. Performance skills will be evaluated to the satisfaction of the instructor.

HARDWOOD TREE GRADING
UNIT VI

TERMINAL OBJECTIVE

After completion of this unit, the student should be able to define terms associated with hardwood tree grading and classify hardwood trees into the three grades of factory lumber classes. He should be able to recognize and evaluate grading defects. This knowledge will be evidenced through demonstration and by scoring eighty-five percent on the unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms associated with hardwood tree grading to the correct definition.
2. List three classes that trees can be cut into as logs.
3. List five major factors affecting grades of the factory class.
4. Match the rules for grade defect evaluation to the correct grade defect.
5. Label the grading zones when given a drawing of a log end.
6. State the principle of factory grades.
7. Arrange in numerical order the procedure for grading logs when given a list of the steps.
8. Demonstrate the ability to:
    a. Identify grade defects.
    b. Grade hardwood trees.

HARDWOOD TREE GRADING
UNIT VI

SUGGESTED ACTIVITIES

I. Instructor:

  A. Provide students with objective sheet.

  B. Provide students with information and job sheets.

  C. Make transparencies.

  D. Discuss terminal and specific objectives.

  E. Discuss information sheet.

  F. Demonstrate and discuss procedures outlined in the job sheets.

  G. Arrange field trips to allow students an opportunity to practice identifying grade defects and grading hardwood trees.

  H. Give test.

II. Students:

  A. Read objectives.

  B. Study information sheet.

  C. Demonstrate the ability to accomplish the procedures outlined in the job sheets.

  D. Participate in field trips.

  E. Take test.

INSTRUCTIONAL MATERIALS

I. Included in this unit:

  A. Objectives

  B. Information sheet

C. Transparency masters

   1. TM 1–Evaluation of Bumps

   2. TM 2–Evaluation of Seams

   3. TM 3–Grading Zones

D. Job sheets

   1. Job Sheet #1–Identify Grade Defects

   2. Job Sheet #2–Grade Hardwood Trees

E. Test

G. Answers to test

II. Reference: NE Forest Experiment Station. *Hardwood Log Grading.* Upper Darby, Pennsylvania: USDA Forest Service.

HARDWOOD TREE GRADING
UNIT VI

INFORMATION SHEET

I. Terms and definitions

   A. Grading--Judging logs and trees into specific classes based on quality of products

   B. Scalable defect--An imperfection that would reduce the volume

   C. Grade defect--An imperfection that reduces the quality of sawn boards

   D. Epicormic bud clusters--Group of sprouts on the side of the tree

   E. Hard hardwoods--Types of wood including sugar maple, beech, birch, sycamore, hackberry, oak, ash, and hickory

   F. Soft hardwoods--Types of wood including soft maple, basswood, yellow-poplar, gum magnolia, willow, cottonwood, and elm

   G. Grub holes--Holes bored into the wood of the tree caused by various insects

   H. Bumps--Log knots including those buried below the bark surface, but indicated by a disturbance of the bark pattern

   I. Seam--A line of overgrowth indicating an old wound

   J. Bird peck--Damage of sap-suckers and woodpeckers made past the bark and into the wood of the tree

   K. Log face--A portion of the log surface equal to one-fourth the circumference, extending the full length of the log

   L. Heart center--Wood in a cylinder in the center of the log with a radius equal to one-fifth of the scaling diameter

   M. Slab zone--A zone starting at the surface and extending into the log for a distance one-fifth of the diameter

   N. Grading doughnut--Wood that is left for grading purposes after the heart center and slab zone are eliminated

II. Log classes

   A. Factory

   B. Construction

   C. Local use

INFORMATION SHEET

III. Major factors of grading factory class logs

A. Position in tree

B. Size

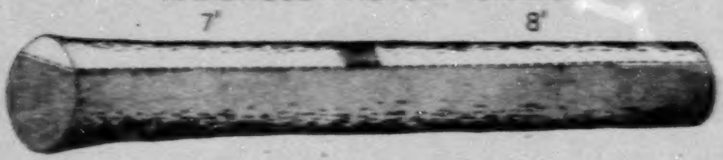
C. Straightness

D. Scalable defect

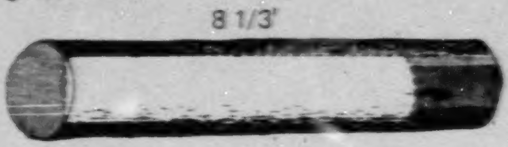
E. Grade defect

Examples:

HARDWOOD FACTORY GRADE 1

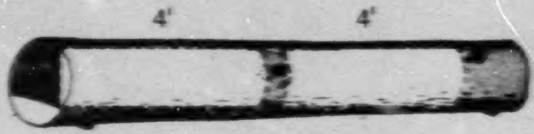


A 16-foot butt log 13 inches in diameter at the small end. More than 5/6 of its grading-face length is clear in two sections 7 and 8 feet long. Less than 40 percent scaling deduction.



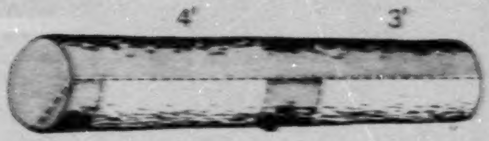
A 10-foot log 16 inches in diameter at the small end. More than 5/6 of its grading-face length is clear in one section 8 feet long. Less than 15 percent deduction for sweep; total deduction is less than 40 percent.

HARDWOOD FACTORY GRADE 2



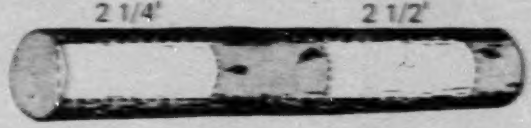
A 10-foot log 11 inches in diameter at the small end. More than 2/3 of its grading-face length is clear in two sections each 4 feet long. Less than 50 percent scaling deduction.

INFORMATION SHEET

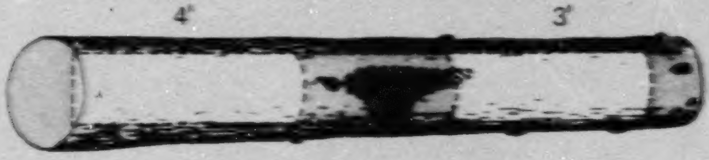


A 9-foot log 12 inches in diameter at the small end. More than 3/4 of its grading-face length is clear in two sections 4 and 3 feet long. Less than 50 percent scaling deduction.

HARDWOOD FACTORY GRADE 3



An 8-foot log 8 inches in diameter at the small end. More than 1/2 of its grading-face length is clear in two sections of 2 feet or longer. Less than 50 percent deduction for rot and sweep.



A 12-foot log 14 inches in diameter at the small end. Interior rot outside the rot zone limits cuttings. However, more than 1/2 of its grading face is clear in two sections, four and three feet long. No sweep; 15 percent deduction for rot is within the 50 percent maximum permitted.

IV. Grade defects

A. Sprouts (epicormic bud clusters) and knots

1. Large (more than 3/8 inch diameter)–Full defect on logs of all sizes, grades, and species

2. Small (3/8 inch diameter or less)

    a. All grades–Hard hardwoods

        1. Logs less than 14 inches–Full defect

        2. Logs 14 inches and more–One-half defect or skip every other one

INFORMATION SHEET

b. All grades–Soft hardwoods

1. Grades 1 and 2–Full defect on logs less than 14 inches

2. One-half defect on logs more than 14 inches

3. Grade 3–No defect

B. Grub holes and grub-caused overgrowths

1. Progressive on face

a. On logs 8-15 inches–Each is a full defect

b. On logs 16-19 inches–Disregard every sixth one

c. On logs 20-23 inches–Disregard every fifth one

d. On logs 24-27 inches–Disregard every fourth one

e. On logs 28 inches or more–Disregard every third one

2. Nonprogressive, horizontally aligned on face–When two or more of these defects are found in a band not more than 6 inches wide across the width of the face, they may be considered as one

C. Bumps (Transparency 1)

1. Bumps must be considered on all logs although in some species low bumps can sometimes be disregarded

2. When bumps are to be log defects, measurements of length affecting clear-cuttings can vary as given:

a. Abrupt bump

1) Length less than three times height

Example: 6 inches long and 4 inches high

2) Stop clear-cutting at change in contour

3) Do not enter bump with clear-cuttings

INFORMATION SHEET

b. Medium bump

1) Length three to six times height

Example: 12 inches long and 2 to 4 inches high

2) Let clear-cutting enter bump one-eight the length on each side

c. Low bump

1) Length six to twelve times height

Example: 12 inches long and 1 to 2 inches high

2) Let clear-cutting enter bump one-fourth the length on each side

d. Surface rise

1) Length more than twelve times height

2) Disregard it

D. Straight seams, frost, cracks, and splits which are not superficial (Transparency 2)

1. Straight seams extending full or part length of the log that can be considered as a line dividing two grading faces can be disregarded

2. Straight seams not confinable to line-dividing grading faces

a. When full length of log, a full defect

b. When extending from one end of log towards middle, include one-third the length on interior end in the clear-cutting

c. When completely in log, extend cuttings one-fourth the length from each end

E. Spiral seams, frost, cracks, and splits which are not superficial--Stop clear-cutting where defect enters face being graded

F. Bird peck

1. Individual pecks are not counted

INFORMATION SHEET

2. Length of pecked area is measured

   (NOTE: A pecked area consists of four or more pecks per square foot.)

   a. Lightly pecked area or fewer than four pecks per square foot--Disregard it

   b. In otherwise No. 3 logs--Disregard all pecked areas

   c. In logs other wise No. 1 and No. 2 with heavily pecked areas or more than four pecks per square foot

      1) If pecks are open, disregard

      2) If pecks are partially or completely occluded, the pecked area is a defect

         (NOTE: Age of peck does not matter. The test is whether callus tissue has formed in the peck holes.)

V. Grading zones (Transparency 3)

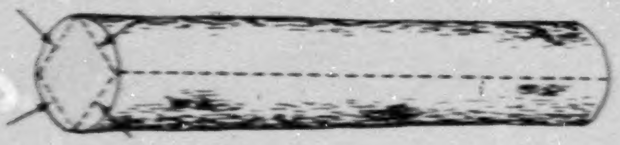
   A. Heart center--One-fifth of the diameter in the center is not graded

   B. Slab zone--One-fifth of the diameter on the surface is not graded

   C. Grading doughnut

VI. Principle of factory grades--Divide the log into four faces; the poorest face of the three best faces is the log grade

   Example:



INFORMATION SHEET

VII. Procedure for grading logs

A. Determine the species of the log to be graded

B. Determine the position the log occupied in the standing tree

C. Establish the scaling diameter

D. Measure the length of useable material in the log or the part that will actually be sawn into boards

(NOTE: Be sure to make sufficient allowance for end trim, usually about three inches of length.)

E. Divide the log pole surface into quarter widths and obtain the greatest number of good faces

F. Determine the best possible grade the log can obtain based on the minimum scaling diameter, log position, and species

(NOTE: The above step gives the maximum number and minimum length of feet for clear-cuttings for the possible grade as given in the Forest Service Standard Specifications for Hardwood Factory Lumber Logs. The chart appears on the following page.)

G. Measure clear-cuttings in each face and check against the specifications for required length needed for the grade to be established

H. If the required clear-cutting length is obtained, proceed to the next step; if the required length is not met, drop back a grade, check specifications for number of cuts and lengths, and regrade face

I. When all four faces have been graded, the log grade is established as the third best face of the total four faces

INFORMATION SHEET

VIII. Forest Service Standard Specifications for Hardwood Factory Lumber Logs

Grading Factors		Log Grades							
		F1			F2				F3
Position in tree		Butts only	Butts & uppers		Butts & uppers				Butts & uppers
Diameter, scaling, inches		13-15	16-19	20+	[2]11	12+			8+
Length without trim, feet		10+			10+	8-9	10-11	12+	9+
Clear cuttings[3] on each 3 best faces	Length, min., feet	7	5	3	3	3	3	3	2
	Number, maximum	2	2	2	2	2	2	3	No Limit
	Fraction of log length required in clear cutting[4]								
Sweep and crook allowance (maximum) in percent gross volume	For logs with less than 1/4 of end in sound defects	15%			30%				50%
	For logs with more than 1/4 of end in sound defects	10%			20%				35%
Total scaling deductions including sweep and crook		[5]40%			[6]50%				50%

End Defects:

[1] Ash and basswood butts can be 12 inches if otherwise meeting requirements for small No. 1's.

[2] Ten-inch logs of all species can be No. 2 if otherwise meeting requirements for small No. 1's.

[3] A clear cutting is a portion of a face free of defects, extending the width of the face.

[4] See table 46.

[5] Otherwise No. 1 logs with 41-60% deductions can be No. 2.

[6] Otherwise No. 2 logs with 52-60% deductions can be No. 3.

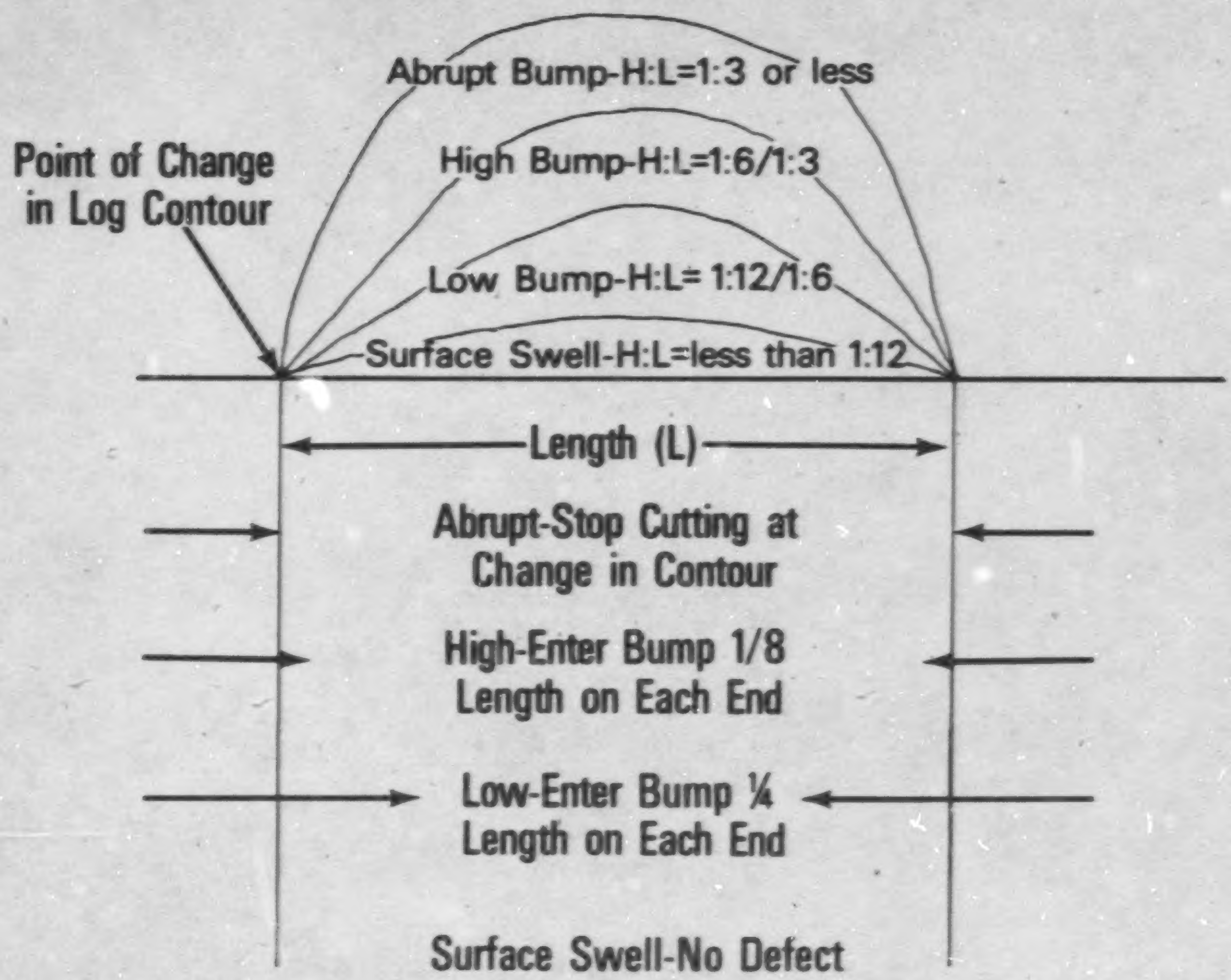
---

*TOTAL CUTTING LENGTH FOR HARDWOOD LOG GRADES

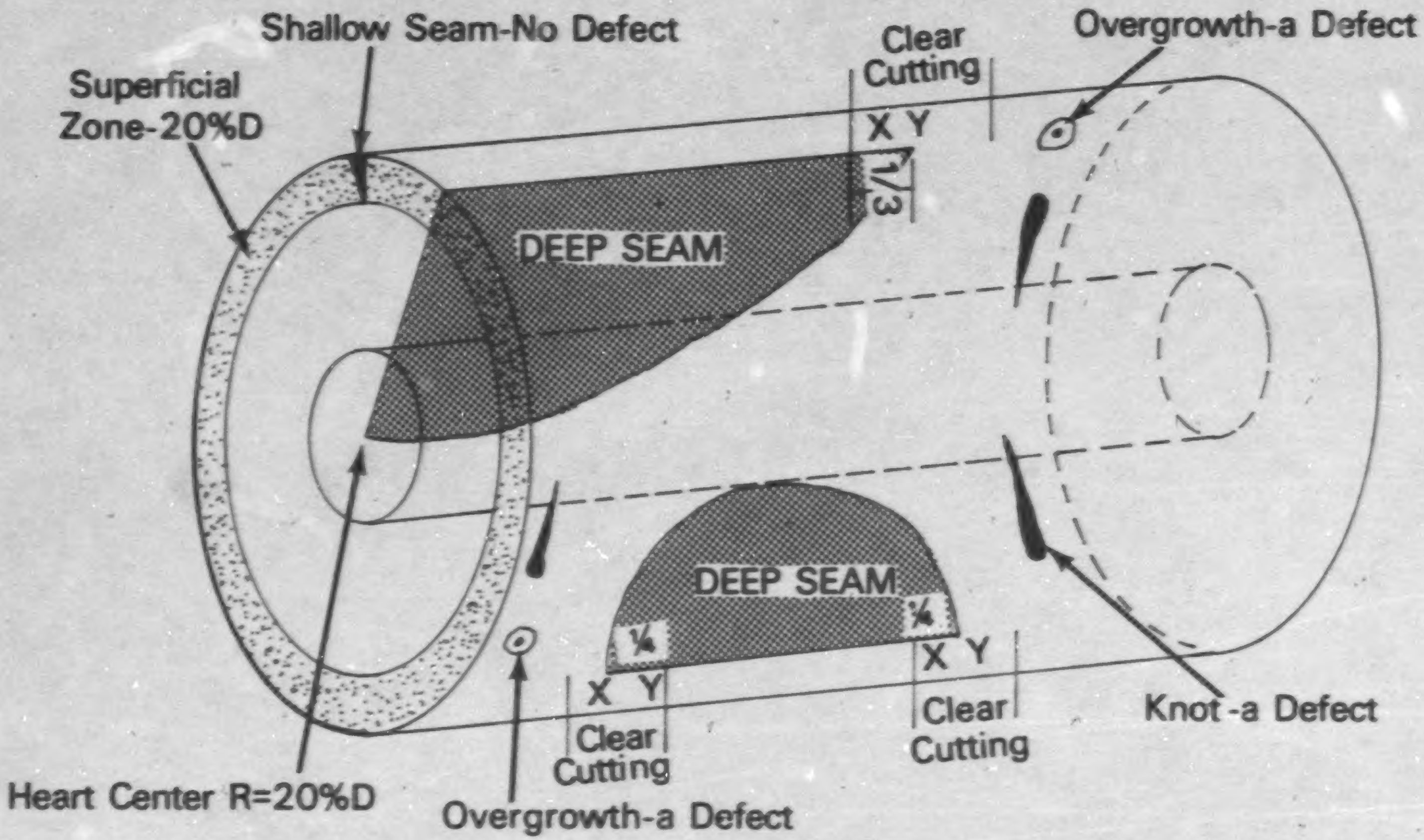
Log Length (feet)	Log grade					
	1		2		3	
	Clear	Lose	Clear	Lose	Clear	Lose
10	8'4"	1'8"	6'8"	3'4"	5'	5'
12	10'	2'	8'	4'	6'	6'
14	11'8"	2'4"	9'4"	4'8"	7'	7'
16	13'4"	2'8"	10'8"	5'4"	8'	8'

For #1 - Length times 2 gives inches can lose.
For #2 - Length times 4 gives inches can lose.
For #3 - Length times 6 gives inches can lose.

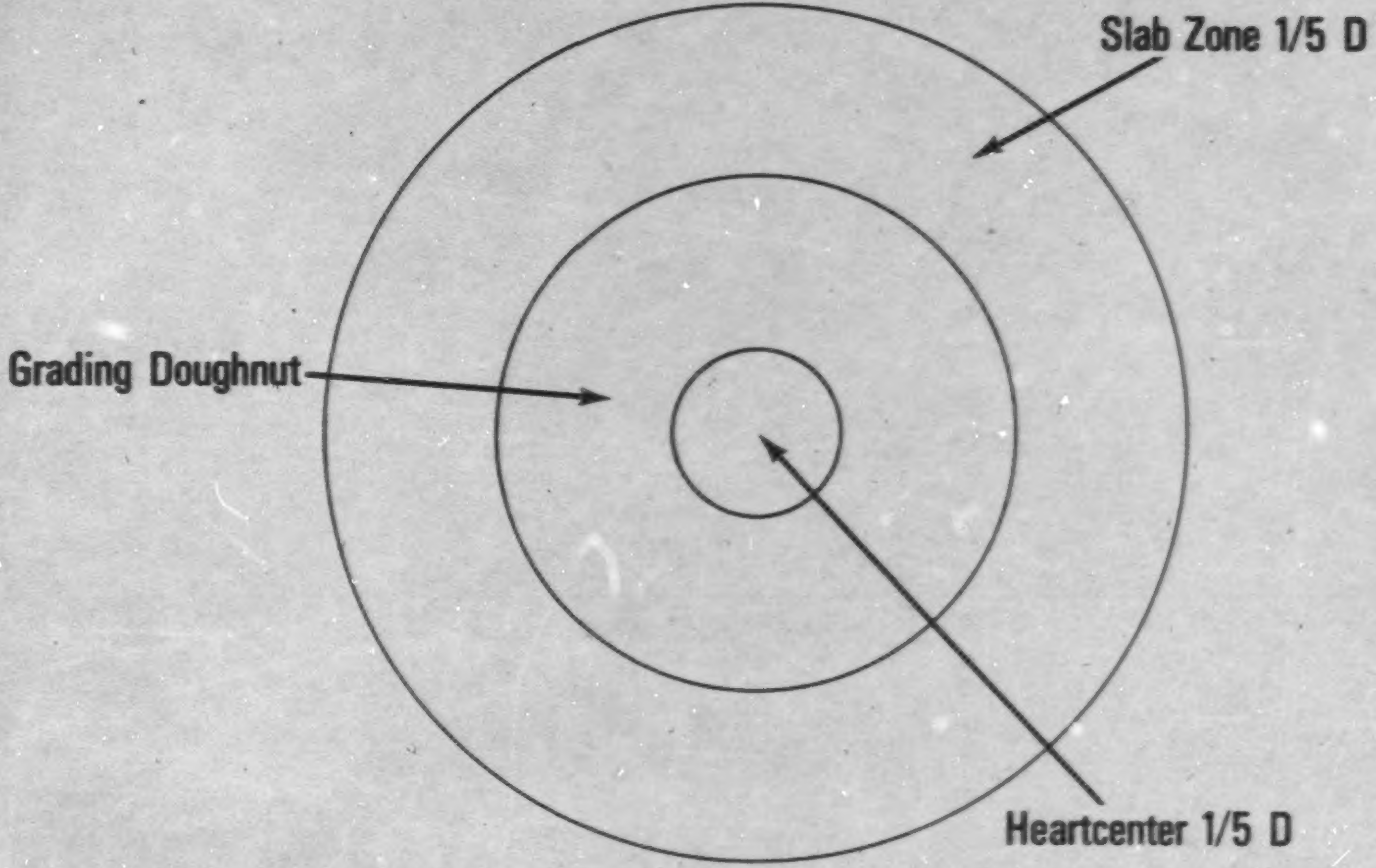
Evaluation of Bumps


Abrupt Bump-H:L=1:3 or less
High Bump-H:L=1:6/1:3
Low Bump-H:L= 1:12/1:6
Surface Swell-H:L=less than 1:12
Point of Change in Log Contour
Length (L)
Abrupt-Stop Cutting at Change in Contour
High-Enter Bump 1/8 Length on Each End
Low-Enter Bump ¼ Length on Each End
Surface Swell-No Defect

Evaluation of Seams


Shallow Seam-No Defect
Superficial Zone-20%D
Clear Cutting
X Y
1/3
Overgrowth-a Defect
DEEP SEAM
DEEP SEAM
¼
¼
X Y
X Y
Clear Cutting
Clear Cutting
Knot -a Defect
Heart Center R=20%D
Overgrowth-a Defect

Grading Zones


Slab Zone 1/5 D
Grading Doughnut
Heartcenter 1/5 D

HARDWOOD TREE GRADING
UNIT VI

JOB SHEET #1–IDENTIFY GRADE DEFECTS

I. Tools and materials needed

- A. Hatchet
- B. Logger's tape
- C. Scale stick
- D. Logs or trees indicated by the instructor
- E. Clipboard, paper, and pencil

II. Procedure

- A. Divide log or tree into four faces; pick the worst face first to align other faces
- B. Use the loggers tape to locate the distance between defects and the ends of the log
- C. On paper, draw the four faces of the log
- D. On the diagram made, locate and identify the type of defects as shown (Figure 1)

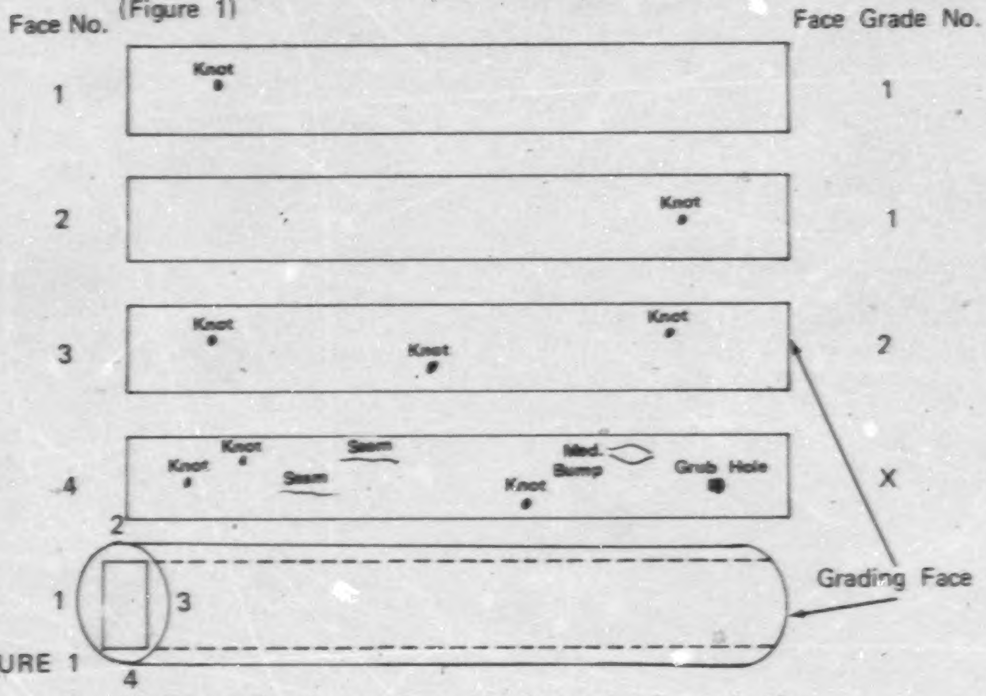

Face No.
Face Grade No.
1
Knot
1
2
Knot
1
3
Knot
Knot
Knot
2
4
Knot
Knot
Knot
Seam
Seam
Med. Bump
Knot
Grub Hole
X
2
1
3
4
Grading Face

FIGURE 1

- E. When completed, turn in to the instructor for evaluation

HARDWOOD TREE GRADING
UNIT VI

JOB SHEET #2–GRADE HARDWOOD TREES

I. Tools and materials needed

  A. Hatchet

  B. Logger's tape

  C. Scale stick

  D. Logs or trees indicated by the instructor

  E. Tally form

  F. Clipboard and pencil

II. Procedure

  A. Determine the species of the log to be graded

  B. Determine the position of the log occupied in the standing tree

  C. Establish the scaling diameter

  D. Measure the length of useable material in the log or the part that will actually be sawn into boards

  E. Divide the log pole surface into quarter widths and obtain the greatest number of good faces

  F. Determine the best possible grade the log can obtain based on the minimum scaling diameter, log position, and species

  G. Measure clear-cuttings in each face and check against the specifications for the required length needed for the grade to be established

  H. If the required clear-cutting length is obtained, proceed to the next step; if the required length is not met, drop back a grade, check specifications for number of cuts and lengths, and regrade face

  I. When all four faces have been graded, the log grade is established as the third best face of the total four faces

  J. Complete the attached form and turn in to the instructor for evaluation

180-C

JOB SHEET #2

No.	Length	Scal. Dia.	Gross Scale	Deductions						Tot. %	Net Scale	Grade	Cause of Degrade*	Log Pos.	Remarks
				S.W. %	Internal										
					L	W	H	Ft.	%						
1															
2															
3															
4															
5															
6															
7															
8															
9															
10															
11															
12															
13															
14															
15															
16															
17															
18															
19															
20															
21															
22															
23															
24															
25															

*D=Size; L=Log Defect; S=Internal Scale Deduction; E=End Defect; C=Crook or Sweep; O=Other

HARDWOOD TREE GRADING
UNIT VI

TEST

1. Match the terms on the right to the correct definition.

_____a. Judging logs and trees into specific classes based on quality of products

_____b. An imperfection that would reduce the volume

_____c. An imperfection that reduces the quality of sawn boards

_____d. Group of sprouts on the side of the tree

_____e. Types of wood including sugar maple, beech, birch, sycamore, hackberry, oak, ash, and hickory

_____f. Types of wood including soft maple, basswood, yellow-poplar, gum magnolia, willow, cottonwood, and elm

_____g. Holes bored into the wood of the tree caused by various insects

_____h. Log knots including those buried below the bark surface but indicated by a disturbance of the bark pattern

_____i. A line of overgrowth indicating an old wound

_____j. Damage of sap-suckers and woodpeckers made past the bark and into the wood of the tree

_____k. A portion of the log surface equal to one-fourth the circumference, extending the full length of the log

1. Epicormic bud cluster
2. Grub holes
3. Seam
4. Scalable defect
5. Grading doughnut
6. Slab zone
7. Hard hardwoods
8. Heart center
9. Grade defect
10. Log face
11. Bird peck
12. Grading
13. Bumps
14. Soft hardwoods

_____ l. Wood in a cylinder in the center of the log with a radius equal to one-fifth of the scaling diameter

_____ m. A zone starting at the surface and extending into the log for a distance one-fifth of the diameter

_____ n. Wood that is left for grading purposes after the heart center and slab zone are eliminated

2. List the three classes that trees can be cut into as logs.

a.

b.

c.

3. List the five major factors affecting grades of the factory class.

a.

b.

c.

d.

e.

4. Match the rules for grade defect evaluation to the defects below.

_____ a. Full defect on all grades

_____ b. Full defect on less than 14"; 1/2 defect on larger diameter

_____ c. Disregard every fifth one as a defect

_____ d. Stop clear-cutting where defects enters face being graded

_____ e. When full length of log, a full defect

_____ f. Enter bump 1/4 the length on each side

_____ g. Disregard

1. Small sprout 3/8" diameter on an oak

2. Low bump

3. Sprial seam

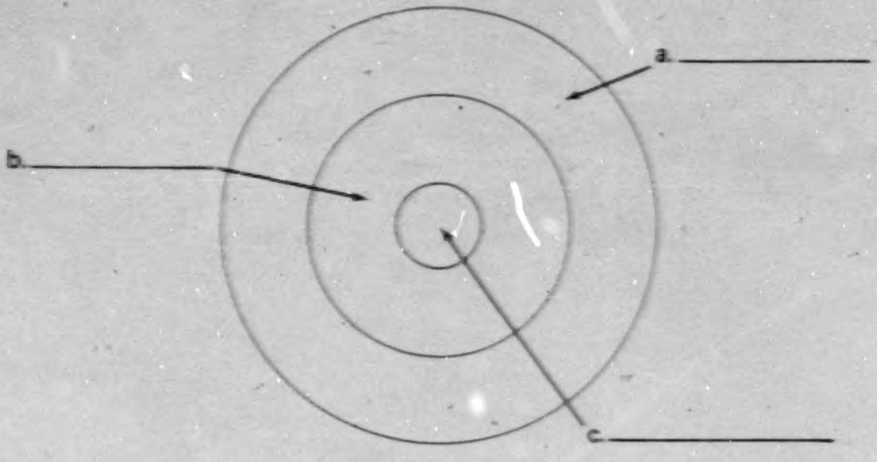
4. Straight seam

5. Sprout 1/2" diameter

6. Bird peck on otherwise No. 3 log

7. Grub hole on 20" log

5. Label the grading zones on the drawing of a log end given below.



6. State the principle of factory grades.

7. Arrange in numerical order the procedure for grading logs.

_____a. Determine the best possible grade the log can obtain based on the minimum scaling diameter, log position, and species

_____b. Determine the position the log occupied in the standing tree

_____c. Measure clear-cuttings in each face and check against the specifications for required length needed for the grade to be established

_____d. When all four faces have been graded, the log grade is established as the third best face of the total four faces

_____e. Measure the length of useable material in the log or the part that will actually be sawn into boards

_____f. Divide the log pole surface into quarter widths and obtain the greatest number of good faces

_____g. If the required clear-cutting length is obtained, proceed to the next step; if the required length is not met, drop back a grade, check specifications for number of cuts and lengths, and regrade face

_____h. Establish the scaling diameter

_____i. Determine the species of the log to be graded

8. Demonstrate the ability to:

   a. Identify grade defects.

   b. Grade hardwood trees.

   (NOTE: If these have not been accomplished prior to the test, ask the instructor when the above activities should be completed.)

HARDWOOD TREE GRADING
UNIT VI

ANSWERS TO TEST

1. a. 12
   b. 4
   c. 9
   d. 1
   e. 7
   f. 14
   g. 2
   h. 13
   i. 3
   j. 11
   k. 10
   l. 8
   m. 6
   n. 5
2. a. Factory
   b. Construction
   c. Local use
3. a. Position in tree
   b. Size
   c. Straightness
   d. Scalable defect
   e. Grade defect
4. a. 5
   b. 1
   c. 7
   d. 3
   e. 4
   f. 2
   g. 6

5. a. Slab zone 1/5 D
   b. Grading doughnut
   c. Heartcenter 1/5 D

6. Divide the log into four faces; the poorest face of the three best faces is the log grade.

7. a. 6
   b. 2
   c. 7
   d. 9
   e. 4
   f. 5
   g. 8
   h. 3
   i. 1

8. Performance skills will be evaluated to the satisfaction of the instructor.

STRIP CRUISING
UNIT VII

TERMINAL OBJECTIVE

After completion of this unit, the student should be able to lay out a strip cruise and perform a strip cruise to determine sawtimber volume. He should be able to determine blow-up factor and tract acreage from strip cruising. This knowledge will be evidenced through demonstration and by scoring eighty-five percent on the unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms associated with strip cruising to the correct definition.
2. Select from a list four reasons for cruising.
3. Determine cruise intensity when given the necessary information for calculation.
4. Arrange in numerical order the procedure for laying out a strip cruise.
5. Name the two methods used to determine the blow-up factor for a strip cruise.
6. List the four steps used to determine total tract acreage from a strip cruise.
7. Name and describe the duties of a two-man strip cruise crew.
8. List the advantages and disadvantages of strip cruising.
9. Demonstrate the ability to:
    a. Lay out a strip cruise.
    b. Determine sawtimber volume by strip cruising.

STRIP CRUISING
UNIT VII

SUGGESTED ACTIVITIES

I. Instructor:

  A. Provide students with objective sheet.

  B. Provide students with information and job sheets.

  C. Make transparency.

  D. Discuss terminal and specific objectives.

  E. Discuss information sheet.

  F. Demonstrate and discuss procedures outlined in the job sheets.

  G. Arrange field trips to allow students an opportunity to practice laying out a strip cruise and determining volume by strip cruising.

  H. Give test.

II. Students:

  A. Read objectives.

  B. Study information sheet.

  C. Demonstrate the ability to accomplish the procedures outlined in the job sheets.

  D. Participate in field trip.

  E. Take test.

INSTRUCTIONAL MATERIALS

I. Included in this unit:

  A. Objectives

  B. Information sheet

C. Transparency Master: TM 1–Strip Cruise Design

D. Job sheets

    1. Job Sheet #1–Lay Out a Strip Cruise

    2. Job Sheet #2–Determine Sawtimber Volume by Strip Cruising

E. Test

F. Answers to test

II. Reference–Avery, T. Eugene. *Forest Measurements*. New York: McGraw-Hill Book Co.

STRIP CRUISING
UNIT VII

INFORMATION SHEET

I. Terms and definitions

  A. Cruising--A forest estimation by sampling

  B. Sample--A part of the whole; plots and strips

  C. Strip cruising--Sampling using continuous strips of uniform width and strips of equal intervals of spacing across the forest acreage

  (NOTE: These are usually one chain strips.)

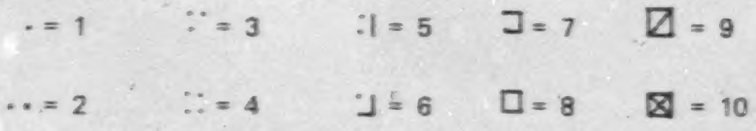
  D. Cruise intensity--The percent of area actually occupied and measured as a sample; expressed as a percent of area

  E. Strip interval--The distance in chains between the strip centerlines

  F. Blow-up factor--A numerical value used to expand a sample volume or acres to total tract volume or acres

  G. Tallying--Recording trees by diameter and height on a form

  Example: Dot-Dash system used:



  H. Borderline trees--Trees just on the edge of the sample area

  I. Compassman--A worker responsible for keeping accurate direction

  J. Estimator--A worker that measures sample plots or strips

  K. Tree volume table--Shows content of trees of various DBH and heights based on a log rule

II. Reasons for cruising

  A. Land and timber appraisal

  B. Timber sales

  C. Management plans

  D. Special surveys: TSI needs, planting areas, insect and disease damage, timber trespass, and blown-down timber

INFORMATION SHEET

III. Determining cruise intensity

- A. Determine acreage sampled in strips
- B. Divide sampled acreage into total tract acreage

  Examples: 2 1/2%, 10%, 20%

  (NOTE: Cruise intensity is dependent on value of the timber products, allowable costs, and desired precision.)

IV. Procedure for strip cruise design (Transparency 1)

- A. Determine acreage to sample from cruise intensity
- B. Determine strip size
  1. One chain most commonly used
  2. One-half chain for dense stands
  3. Two chains for sparse stands
- C. Determine strip interval based on acreage
- D. Determine starting point
- E. Determine strip direction

  (NOTE: Strips should cross topography and drainage at right angles.)
- F. Locate first strip one-half the strip interval from starting point

  (NOTE: This will end with the last strip one-half the strip interval instead of on the tract boundary.)

V. Methods used to determine blow-up factor

- A. Divide cruise intensity into 100%
- B. Divide tract acreage by sample acres

  (NOTE: Sample timber volumes are expanded by blown-up factor.)

  Examples:

Cruise Intensity	Blow-up Factor
2 1/2%	40
5%	20
10%	10
20%	5

INFORMATION SHEET

VI. Steps used to determine acreage from strip cruising

- A. Determine total length of strips in chains
- B. Multiply strip width times lineal distance to find the number of square chains
- C. Divide square chains by ten to determine sample acres
- D. Multiply sample acres times blow-up factor to find total tract acreage

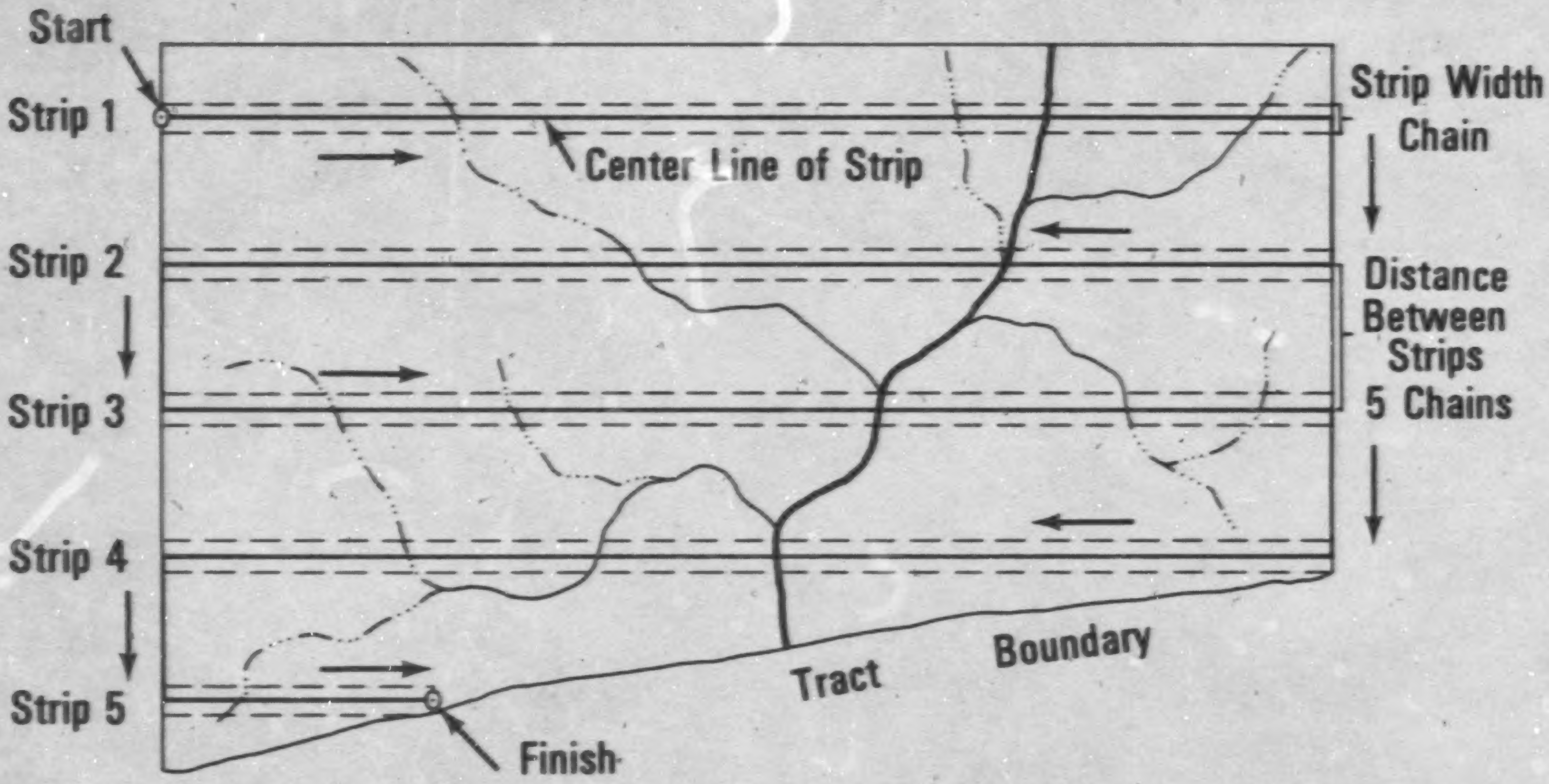
VII. Duties of a two-man strip cruise crew

- A. Compassman--Locates centerline of strip using a compass, topographic tape, and Abney hand level; tallies for estimator
- B. Estimator--Acts as rear chainman; paces out from chain for strip width and estimates or measures tree diameters and heights

VIII. Strip cruising

- A. Advantages
    1. No loss of time in sampling as compared to plot locations of sampling
    2. Less problems with borderline trees than plot cruising
    3. Less risk than working alone in the woods
- B. Disadvantages
    1. Errors from estimating strip width
    2. Tendency to underestimate tree heights
    3. Brush more hindersome than plot cruising

Strip Cruise Design


Start
Strip 1
Center Line of Strip
Strip Width
Chain
Strip 2
Distance
Between
Strips
5 Chains
Strip 3
Strip 4
Strip 5
Tract
Boundary
Finish

STRIP CRUISING
UNIT VII

JOB SHEET #1--LAY OUT A STRIP CRUISE

After dividing into groups of two, design a strip cruise on forty acres of timberland indicated by the instructor. Plan for a cruise intensity of 10%. When completed, turn in to the instructor for evaluation.

I. Tools and materials needed

   A. Compass

   B. Topographic tape

   C. Abney hand level

   D. Clipboard and pencil

   E. Area indicated by instructor

II. Procedure

   A. Determine acreage to sample from cruise intensity

   B. Determine strip size

      1. One chain most commonly used

      2. One-half chain for dense stands

      3. Two chains for sparse stands

   C. Determine strip interval based on acreage

   D. Determine starting point

   E. Determine strip direction

   (NOTE: Strips should cross topography and drainage at right angles.)

   F. Locate first strip one-half the strip interval from starting point

   (NOTE: This will end with the last strip one-half the strip interval instead of on the tract boundary.)

   G. Draw in the 40 acre diagram given

      1. Starting point

      2. Strip width

JOB SHEET #1

3. Strip interval
4. Strip direction
5. Total strips to take

40 ACRES

STRIP CRUISING
UNIT VII

JOB SHEET #2--DETERMINE SAWTIMBER VOLUME BY STRIP CRUISING

After dividing into groups of two, use the plan developed in Job Sheet #1 of this unit (after evaluation and correction by the instructor). When completed, turn in to the instructor for evaluation.

I. Tools and materials needed

- A. Compass
- B. Topographic tape
- C. Abney hand level
- D. Diameter tape
- E. 50' tape
- F. Clipboard and pencil
- G. Tally sheet
- H. Tree volume table

II. Procedure

- A. Compassman
    1. Locate the centerline of each strip using a compass
    2. Act as head chairman using a topographic tape
    3. Measure slopes with Abney hand level
    4. Tally for estimator
- B. Estimator
    1. Act as rear chainman
    2. Determine strip by pacing and by measuring with a 50' tape
    3. Estimate DBH and heights of trees found on the strip
    4. Call out estimates to the compassman for tally

JOB SHEET #2

C. Alternate jobs on each strip

D. Tally all sawtimber trees 9.0" DBH and larger and up to 7" diameter top on the strips using the attached tally sheet

E. Estimate DBH and heights; measure every tenth tree to develop skill in estimation

F. Use dot-dash system of tally in blanks provided on the tally sheet for appropriate DBH and merchantable heights

G. When strips are completed, figure sawtimber volume found on the strips using the attached tree volume table

H. Determine blow-up factor

I. Expand strip volume for total 40 acre volume

Total 40 acre volume of sawtimber __________bd. ft.

JOB SHEET #2

Form No. 1001

Tract____________________

Owner____________________

Marker____________________

Date____________________

TIMBER MARKETING TALLY SHEET

FORESTRY DIVISION
STATE DEPARTMENT OF AGRICULTURE
122 CAPITOL BUILDING
OKLAHOMA CITY, OKLA. 73105

DATE	TOTAL TALLY

POST & POLES

______ th TREE TALLY

DIA.		TOTAL MERCHANTABLE HT. — FEET																		
		6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42
2.5 TO 3.5	3																			
3.6 TO 4.5	4																			
4.6 TO 5.5	5																			
5.6 TO 6.5	6																			
6.6 TO 7.5	7																			
7.6 TO 8.5	8																			
8.6 TO 9.5	9																			

SAW TIMBER—100% Tally 16 Ft. Logs

Sound / Defective

DIA.		½ 8' – 12'	1 12' – 20'	1½ 21' – 27'	2 28' – 37'	2½ 38' – 45'	3 46' – 53'	3½ 54' – 60'	4 61' – 68'	LARGE TREES DIA.	HT.	S D
9.0 – 10.9	10											
11.0 – 12.9	12											
13.0 – 14.9	14											
15.0 – 16.9	16											
17.0 – 18.9	18											
19.0 – 20.9	20											
21.0 – 22.9	22											
23.0 – 24.9	24											
25.0 – 26.9	26											
27.0 – 28.9	28											
29.0 – 30.9	30											

JOB SHEET #2
TREE VOLUME TABLE

Mesavage - Girard
USDA

FC 78
DOYLE

Tree diameter (inches)	VOLUME (board feet) BY NUMBER OF USABLE 16-FOOT LOGS								
	1	1 1/2	2	2 1/2	3	3 1/2	4	4 1/2	5
10	14	17	20	21	22	—	—	—	—
11	22	27	32	35	38	—	—	—	—
12	29	36	43	48	53	54	56	—	—
13	38	48	59	66	73	76	80	—	—
14	48	62	75	84	93	98	103	—	—
15	60	78	96	108	121	128	136	—	—
16	72	94	116	132	149	160	170	—	—
17	86	113	140	161	182	196	209	—	—
18	100	132	164	190	215	232	248	—	—
19	118	156	194	225	256	276	297	—	—
20	135	180	225	261	297	322	346	364	383
21	154	207	260	302	344	374	404	428	452
22	174	234	295	344	392	427	462	492	521
23	195	264	332	388	444	483	522	558	594
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25	241	328	414	486	558	609	660	709	758
26	266	362	459	539	619	678	737	793	849
27	292	398	505	594	684	749	814	877	940
28	317	434	551	650	750	820	890	961	1,032
29	346	475	604	714	824	902	980	1,061	1,142
30	376	517	658	778	898	984	1,069	1,160	1,251
31	408	562	717	850	983	1,080	1,176	1,273	1,370
32	441	608	776	922	1,068	1,176	1,283	1,386	1,488
33	474	654	835	994	1,152	1,268	1,385	1,497	1,609
34	506	700	894	1,064	1,235	1,361	1,487	1,608	1,730
35	544	754	964	1,149	1,334	1,472	1,610	1,743	1,876
36	581	308	1,035	1,234	1,434	1,583	1,732	1,878	2,023
37	618	860	1,102	1,318	1,534	1,694	1,854	2,013	2,172
38	655	912	1,170	1,402	1,635	1,805	1,975	2,148	2,322
39	698	974	1,250	1,498	1,746	1,932	2,118	2,298	2,479
40	740	1,035	1,330	1,594	1,858	2,059	2,260	2,448	2,636

Adjust volumes 4% for each 1% change in FC

STRIP CRUISING
UNIT VII

TEST

1. Match the terms on the right to the correct definition.

_____a. A forest estimation by sampling

_____b. A part of the whole; plots and strips

_____c. Sampling using continuous strips of uniform width and strips of equal intervals of spacing across the forest acreage

_____d. The percent of area actually occupied and measured as a sample; expressed as a percent of area

_____e. The distance in chains between the strip centerlines

_____f. A numerical value used to expand a sample volume or acres to total tract volume or acres

_____g. Recording trees by diameter and height on a form

_____h. Trees just on the edge of the sample area

_____i. A worker responsible for keeping accurate direction

_____j. A worker that measures sample plots or strips

_____k. Shows content of trees of various DBH and heights based on a log rule

1. Blow-up factor
2. Cruise intensity
3. Compassman
4. Tallying
5. Cruising
6. Tree volume table
7. Borderline trees
8. Estimator
9. Sample
10. Strip interval
11. Strip cruising

2. Select from the list below the four reasons for cruising by placing an "X" in the blanks provided.

_____a. Land ownership

_____b. Land and timber appraisal

_____c. Management plans

_____d. Land location

_____e. Survey of timber trespass

_____f. Timber sales

3. Determine the cruise intensity for this cruise: 4 strips 1 chain wide and 80 chains long on 640 acres.

4. Arrange in numerical order the procedure for laying out a strip cruise.

_____a. Determine strip direction

_____b. Determine starting point

_____c. Determine strip interval based on acreage

_____d. Determine acreage to sample from cruise intensity

_____e. Locate first strip one-half the strip interval from starting point

_____f. Determine strip size

5. Name the two methods used to determine the blow-up factor for a strip cruise.

a.

b.

6. List the four steps used to determine total tract acreage from a strip cruise.

a.

b.

c.

d.

7. Name and describe the duties of each man in a two-man strip cruise crew.

    a.

    b.

8. List the advantages and disadvantages of strip cruising.

    a. Advantages

        1)

        2)

        3)

    b. Disadvantages

        1)

        2)

        3)

9. Demonstrate the ability to:

    a. Lay out a strip cruise.

    b. Determine sawtimber volume by strip cruising.

STRIP CRUISING
UNIT VII

ANSWERS TO TEST

1. a. 5
   b. 9
   c. 11
   d. 2
   e. 10
   f. 1
   g. 4
   h. 7
   i. 3
   j. 8
   k. 6
2. b, c, e, f
3. 20%
4. a. 5
   b. 4
   c. 3
   d. 1
   e. 6
   f. 2
5. a. Divide cruise intensity into 100%
   b. Divide tract acreage by sample acres
6. a. Determine total length of strips in chains
   b. Multiply strip width times lineal distance to find the number of square chains

c. Divide square chains by ten to determine sample acres

d. Multiply sample acres times blow-up factor to find total tract acreage

7. a. Compassman--Locates centerline of strip using a compass, topographic tape, and Abney hand level; tallies for estimator

b. Estimator--Acts as rear chainman; paces out from chain for strip width and estimates or measures tree diameters and heights

8. a. Advantages

1) No loss of time in sampling as compared to plot locations of sampling

2) Less problems with borderline trees than plot cruising

3) Less risk than working alone in the woods

b. Disadvantages

1) Errors from estimating strip width

2) Tendency to underestimate tree heights

3) Brush more hindersome than plot cruising

9. Performance skills will be evaluated to the satisfaction of the instructor.

PLOT CRUISING
UNIT VIII

TERMINAL OBJECTIVE

After completion of this unit, the student should be able to select from a list methods of planning a sample layout and distinguish between advantages and disadvantages of plot cruising. He should also be able to complete a plot cruise layout and perform a plot cruise to determine sawtimber and pulpwood volume. This knowledge will be evidenced through demonstration and by scoring eighty-five percent on the unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms associated with plot cruising to the correct definition.
2. Select from a list the commonly used plot forms and sizes.
3. State the commonly used plot sizes when given the plot radii.
4. List two methods of determining cruise intensity for plot cruising.
5. Select from a list three methods of planning a sampling layout.
6. Arrange in numerical order the steps to complete a systematic plot cruise layout.
7. Arrange in numerical order the steps for plot cruising.
8. Distinguish between the advantages and disadvantages of plot cruising as compared to strip cruising.
9. Demonstrate the ability to:
    a. Complete a systematic grid sample plot cruise layout.
    b. Determine sawtimber and pulpwood volume by plot cruising.

PLOT CRUISING
UNIT VIII

SUGGESTED ACTIVITIES

I. Instructor:

- A. Provide students with objective sheet.
- B. Provide students with information and job sheets.
- C. Make transparency.
- D. Discuss terminal and specific objectives.
- E. Discuss information sheet.
- F. Demonstrate and discuss procedures outlined in the job sheets.
- G. Arrange field trips to allow students an opportunity to perform the activities outlined in the job sheets.
- H. Give test.

II. Students:

- A. Read objectives.
- B. Study information sheet.
- C. Demonstrate the ability to accomplish the procedures outlined in the job sheets.
- D. Participate in field trip.
- E. Take test.

INSTRUCTIONAL MATERIALS

I. Included in this unit:

- A. Objectives
- B. Information sheet
- C. Transparency master: TM 1–Plot Cruise Layout

D. Job sheets

  1. Job Sheet #1–Complete a Systematic Grid Sample Plot Cruise Layout

  2. Job Sheet #2–Determine Sawtimber and Pulpwood Volume by Plot Cruising

E. Test

F. Answers to test

II. Reference–Avery, T. Eugene. *Forest Measurements.* New York: McGraw-Hill.

PLOT CRUISING
UNIT VIII

INFORMATION SHEET

I. Terms and definitions

A. Plot cruising--Sampling using plots of a predetermined size and arranged systematically or randomly

B. Pulpwood--Small trees and defective larger trees used to make pulp for paper

C. Radii--Plural for radius, the distance from the center of a circle to the border

D. Systematic grid sample--A sampling layout where the plots to be sampled are arranged equidistant over the tract

E. Simple random sample--A sampling layout where the plots to be sampled are selected at random or by chance

F. Stratified random sample--A sampling layout where the plots to be sampled are randomly selected for each known division of a tract

G. Layout--A plan or design

H. Cardinal--The principal points of a compass or north, south, east, and west

II. Plot sizes commonly used

A. Forms

1. Circular
2. Square

B. Area sizes in acres

1. 1/100
2. 1/10
3. 1/5
4. 1/4

INFORMATION SHEET

III. Radius of commonly used plot sizes

Plot Size (Acres)	Plot Radius (Feet)
A. 1/100	11.8
B. 1/10	37.2
C. 1/5	52.7
D. 1/4	58.9

IV. Methods of determining cruise intensity

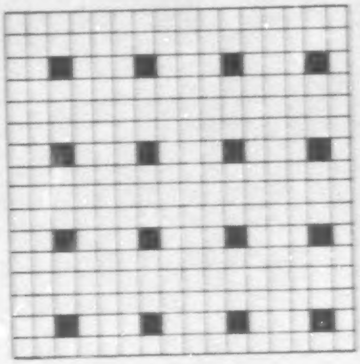
A. $\frac{\text{Acres cruised}}{\text{Total tract acres}}$

B. $\frac{\text{Plot size in acres}}{\text{Acres represented by each plot}} \times 100$

V. Methods of planning a sampling layout

A. Systematic grid sample

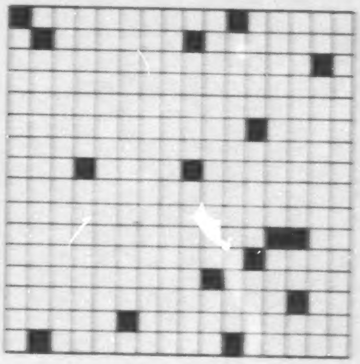
Example:



INFORMATION SHEET

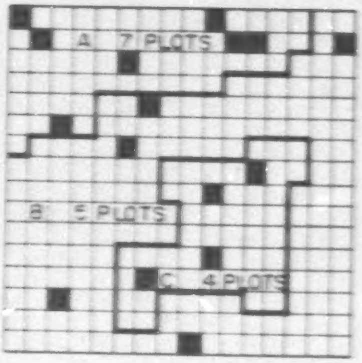
B. Simple random sample

Example:



C. Stratified random sample

Example:


A 7 PLOTS
B 5 PLOTS
C 4 PLOTS

INFORMATION SHEET

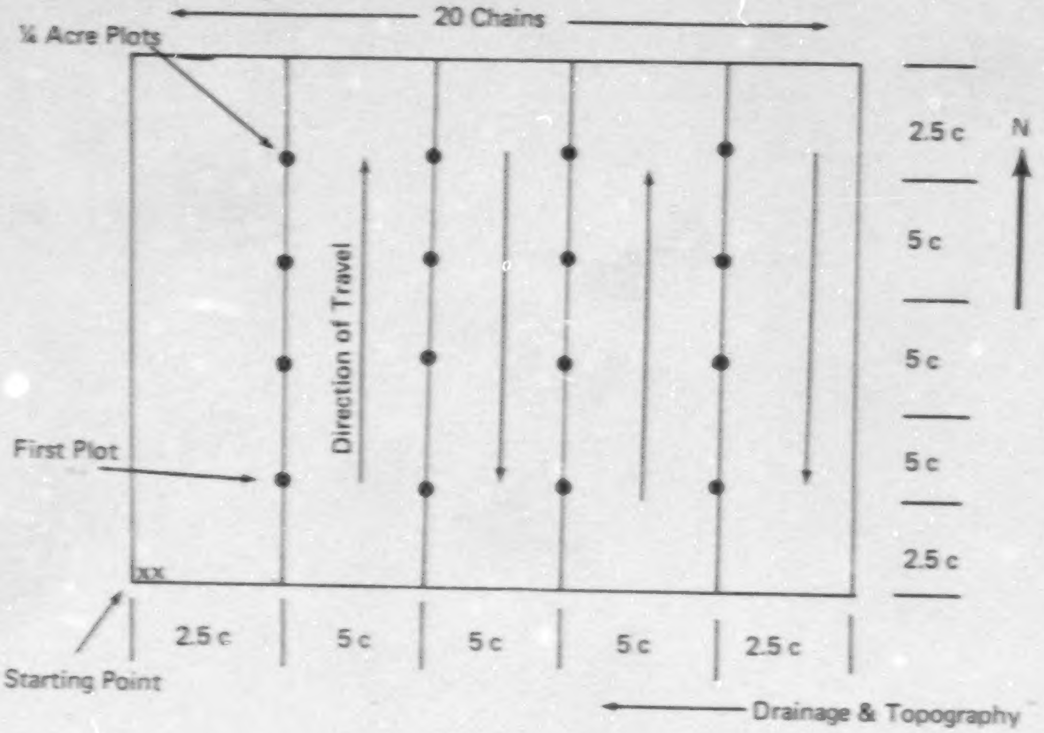
VI. Steps to complete a systematic plot cruise layout (Transparency 1)

- A. Determine cruise intensity needed
- B. Determine acres to cruise
- C. Determine number and size of plots needed
- D. Determine tract acres each plot represents
- E. Determine grid pattern based on the square chains in the acres of the above step
- F. Determine plot interval and line interval locations
- G. Locate starting point
- H. Example of a systematic grid sample plot cruise:
  1. Cruise intensity, 10%
  2. Plot size, 1/4 acre
  3. Tract, 40 acres
     - a. Number of plots = .10 X 40 = 4 acres; 4 X 4 = 16 plots
     - b. Representative acres = 40 ÷ 16 = 2.5 acres
     - c. Representative square chains = 2.5 X 10 = 25 square chains
     - d. Square root of representative square chains = $\sqrt{25}$ = 5 chains, or 5 chains by 5 chains grid pattern

INFORMATION SHEET

e. Starting point, lines, and plot locations

40 Acres



20 Chains
¼ Acre Plots
First Plot
Direction of Travel
xx
Starting Point
2.5 c
5 c
5 c
5 c
2.5 c
2.5 c
5 c
5 c
5 c
2.5 c
N
Drainage & Topography

VII. Steps for plot cruising (one-man crew)

A. From starting point, use cardinal points for direction

B. Locate first line one-half the interval distance

C. Locate first point one-half the plot interval

D. Establish plot radius using tape measure

E. Estimate or measure the size of all trees on the plot and indicate the species desired

F. Measure radius to all borderline trees

G. Pace or chain the distance to the next plot and repeat

INFORMATION SHEET

VIII. Advantages and disadvantages of plot cruising as compared to strip cruising

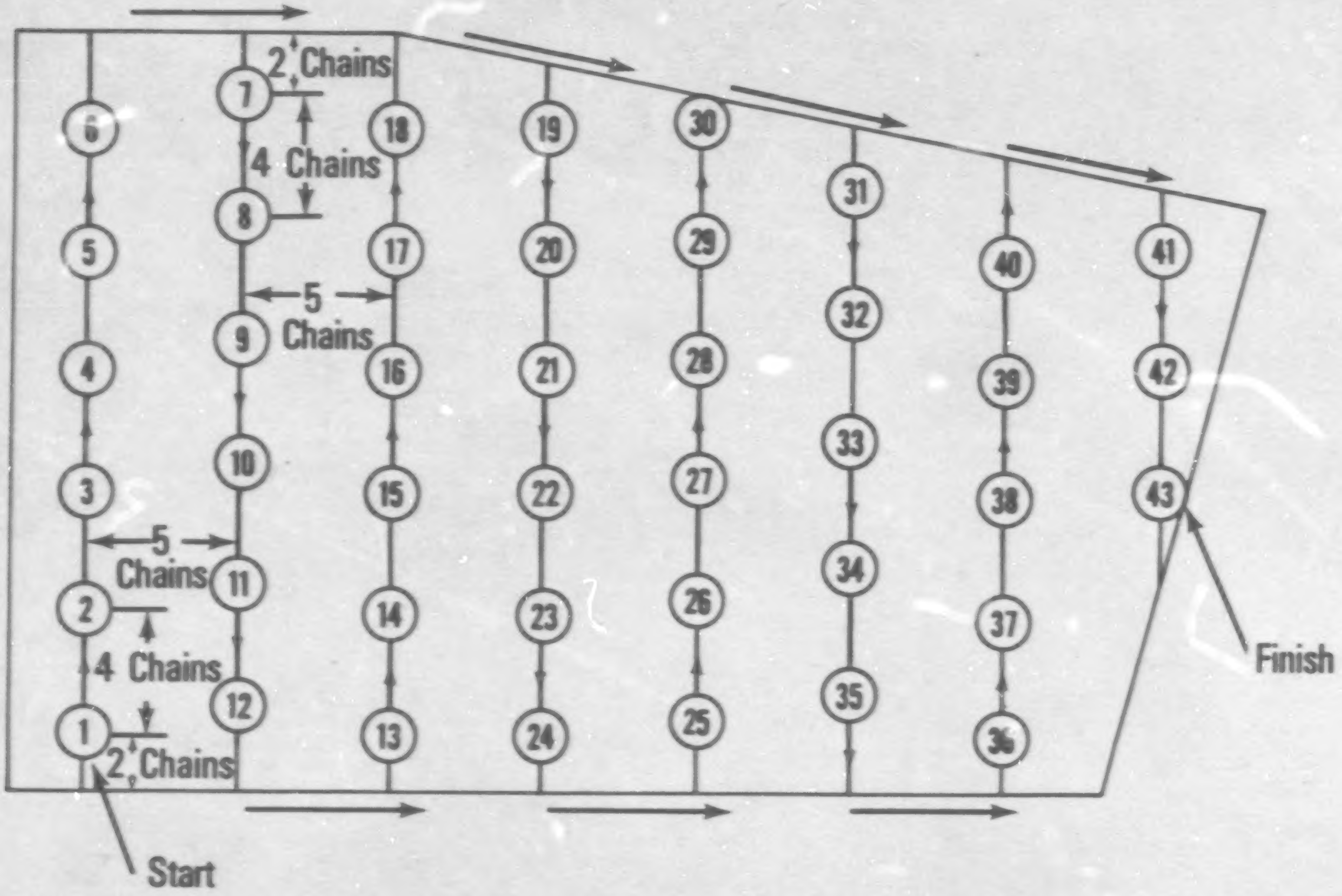
A. Advantages

1. Suitable for one-man crews
2. Brush not a hinderance
3. Easier to make a more detailed study of trees

B. Disadvantages

1. Hazardous for one man to work alone
2. Generally requires more measurement of borderline trees
3. Considerable time spent walking from one plot to another

Plot Cruise Layout


2 Chains
4 Chains
5 Chains
5 Chains
4 Chains
2 Chains
1
2
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10
11
12
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37
38
39
40
41
42
43
Start
Finish

PLOT CRUISING
UNIT VIII

JOB SHEET #1–COMPLETE A SYSTEMATIC GRID SAMPLE PLOT CRUISE LAYOUT

I. Tools and materials needed

   A. Compass

   B. Pacing skill

   C. Clipboard and pencil

II. Procedure

   A. Group in teams of two

   B. Plan for a cruise intensity of 10% and 1/5 acre plots on 40 acres of timberland indicated by the instructor

   C. Determine number of plots for the cruise intensity and size of tract

   D. Determine representative acres for each plot

   E. Convert the representative acres to square chains

   F. Obtain the square root in chains for the representative square chains or for the appropriate rectangle grid

   G. Locate plots and lines on the following 40 acre diagram and indicate the starting point

   H. Be sure to locate first line and first plot one-half the distance determined as the interval

   I. When completed, turn in to the instructor for evaluation

40 acres

PLOT CRUISING
UNIT VIII

JOB SHEET #2–DETERMINE SAWTIMBER AND PULPWOOD VOLUME BY PLOT CRUISING

I. Tools and materials needed

- A. Compass
- B. Suunto clinometer
- C. 100' tape
- D. Diameter tape
- E. Clipboard and pencil
- F. Tally sheet
- G. Tree volume tables

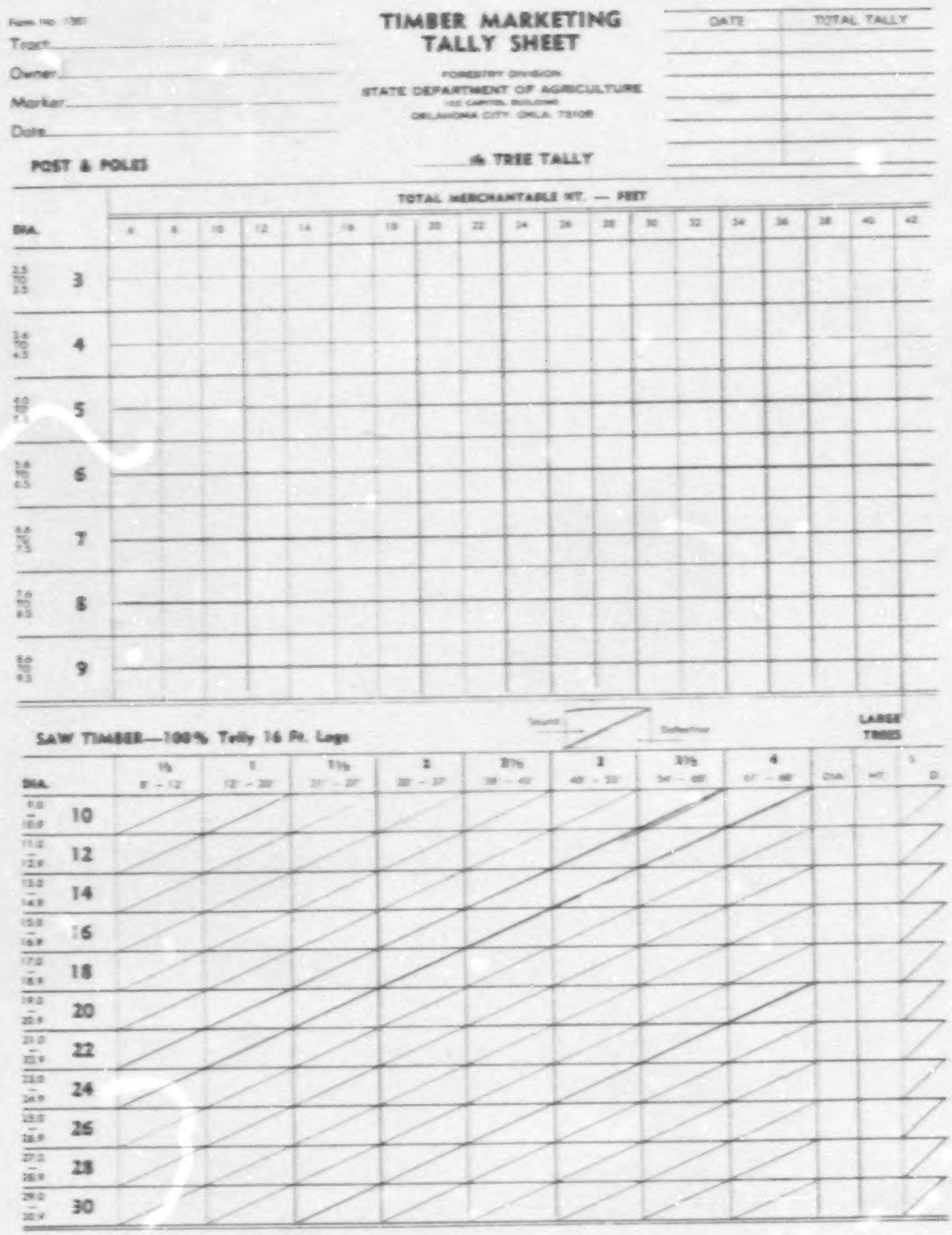
II. Procedure

- A. Group in teams of two (compassman and estimator)
- B. Locate first plot using compass and pacing
- C. Tally all sawtimber trees 9.0" DBH and larger up to 7" diameter top on the plot using the attached tally sheet
- D. Tally all pulpwood trees 4.6" DBH up to 8.9" DBH and to a 4" diameter on the plot using the attached tally sheet
- E. Estimate DBH and measure every tenth tree to develop skill in estimation
- F. Use dot-dash system of tally in blanks provided on the tally sheet for appropriate DBH and merchantable heights
- G. Alternate jobs on each line of plots
- H. When plots are completed, figure sawtimber and pulpwood volume found on the plots using the attached tree volume table
- I. Determine blow-up factor
- J. Expand plot volumes for total 40 acre volume

  Total 40 acre volume

  1. Sawtimber ________________ bd. ft.
  2. Pulpwood ________________ cu. ft.
- K. When completed, turn in tally sheet to instructor for evaluation

JOB SHEET #2



Form No. [illegible]

Tract____________________

Owner____________________

Marker____________________

Date____________________

TIMBER MARKETING TALLY SHEET

FORESTRY DIVISION
STATE DEPARTMENT OF AGRICULTURE
[illegible] CAPITOL BUILDING
OKLAHOMA CITY, OKLA. 73105

DATE	TOTAL TALLY

______th TREE TALLY

POST & POLES

DIA.		TOTAL MERCHANTABLE HT. — FEET																		
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7.6 TO 8.5	8																			
8.6 TO 9.5	9																			

SAW TIMBER—100% Tally 16 Ft. Logs

Sound
Defective

DIA.		½	1	1½	2	2½	3	3½	4	LARGE TREES		
		8' – 12'	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	DIA.	HT.	D
9.0 — 10.9	10											
11.0 — 12.9	12											
13.0 — 14.9	14											
15.0 — 16.9	16											
17.0 — 18.9	18											
19.0 — 20.9	20											
21.0 — 22.9	22											
23.0 — 24.9	24											
25.0 — 26.9	26											
27.0 — 28.9	28											
29.0 — 30.9	30											

JOB SHEET #2
TREE VOLUME TABLE

Mesavage - Girard
USDA

FC 78
DOYLE

Tree diameter (inches)	VOLUME (board feet) BY NUMBER OF USABLE 16-FOOT LOGS								
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11	22	27	32	35	38	—	—	—	—
12	29	36	43	48	53	54	56	—	—
13	38	48	59	66	73	76	80	—	—
14	48	62	75	84	93	98	103	—	—
15	60	78	96	108	121	128	136	—	—
16	72	94	116	132	149	160	170	—	—
17	86	113	140	161	182	196	209	—	—
18	100	132	164	190	215	232	248	—	—
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29	346	475	604	714	824	902	980	1,061	1,142
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31	408	562	717	850	983	1,080	1,176	1,273	1,370
32	441	608	776	922	1,068	1,176	1,283	1,386	1,488
33	474	654	835	994	1,152	1,268	1,385	1,497	1,609
34	506	700	894	1,064	1,235	1,361	1,487	1,608	1,730
35	544	754	964	1,149	1,334	1,472	1,610	1,743	1,876
36	581	308	1,035	1,234	1,434	1,583	1,732	1,878	2,023
37	618	860	1,102	1,318	1,534	1,694	1,854	2,013	2,172
38	655	912	1,170	1,402	1,635	1,805	1,975	2,148	2,322
39	698	974	1,250	1,498	1,746	1,932	2,118	2,298	2,479
40	740	1,035	1,330	1,594	1,858	2,059	2,260	2,448	2,636

Adjust volumes 4% for each 1% change in FC

PLOT CRUISING
UNIT VIII

TEST

1. Match the terms on the right to the correct definition.

_____a. Sampling using plots of a predetermined size and arranged systematically or randomly

_____b. Small trees and defective larger trees used to make pulp for paper

_____c. Plural for radius, the distance from the center of a circle to the border

_____d. A sampling layout where the plots to be sampled are arranged equidistant over the tract

_____e. A sampling layout where the plots to be sampled are selected at random or by chance

_____f. A sampling layout where the plots to be sampled are randomly selected for each known division of a tract

_____g. A plan or design

_____h. The principal points of a compass or north, south, east, and west

1. Systematic grid sample
2. Stratified random sample
3. Pulpwood
4. Simple random sample
5. Layout
6. Plot cruising
7. Cardinal
8. Radii

2. Select from the list below the commonly used plot forms and sizes. Place an "X" in the appropriate blanks.

_____a. 1/3

_____b. 1/8

_____c. 1/10

_____d. 1/16

_____e. 1/20

_____f. 1/5

_____g. 1/4

_____h. 1/100

_____i. 1/50

_____j. Triangle

_____k. Circular

_____l. Rectangle

_____m. Square

3. State the commonly used plot sizes for the plot radii given.

a. 52.7'–

c. 58.9'–

b. 11.8'–

d. 37.2'–

4. List two methods of determining cruise intensity for plot cruising.

a.

b.

5. Select from this list three methods of planning a sampling layout by placing an "X" in the appropriate blanks.

______a. Systematic strip sample

______b. Systematic grid sample

______c. Systematic random sample

______d. Simple random sample

______e. Stratified random sample

______f. Simple systematic sample

6. Arrange in numerical order the following steps to complete a systematic plot cruise layout.

______a. Determine number and size of plots needed

______b. Locate starting point

______c. Determine cruise intensity needed

______d. Determine grid pattern based on the square chains in the acres of the above step

______e. Determine tract acres each plot represents

______f. Determine acres to cruise

______g. Determine plot interval and line interval locations

7. Arrange in numerical order the following steps for plot cruising.

______a. Measure radius to all borderline trees

______b. Locate first line one-half the interval distance

______c. Establish plot radius using tape measure

______d. From starting point, use cardinal points for direction _____e. Pace or chain the distance to the next plot and repeat

_____f. Locate first point one-half the plot interval

_____g. Estimate or measure the size of all trees on the plot and indicate the species desired

8. Distinguish between the advantages and disadvantages of plot cruising as compared to strip cruising from the list below. Place an "A" for advantage or a "D" for disadvantage in the correct blanks.

_____a. Generally requires more measurement of borderline trees

_____b. Suitable for one-man crews

_____c. Considerable time spent walking from one plot to another

_____d. Easier to make more detailed study of trees

_____e. Brush not a hinderance

_____f. Hazardous for one man to work alone

9. Demonstrate the ability to:

a. Complete a systematic grid sample plot cruise layout.

b. Determine sawtimber and pulpwood volume by plot cruising.

(NOTE: If these have not been accomplished prior to the test, ask the instructor when the above activities should be completed.)

PLOT CRUISING
UNIT VIII

ANSWERS TO TEST

1. a. 6
   b. 3
   c. 8
   d. 1
   e. 4
   f. 2
   g. 5
   h. 7

2. c, f, g, h, k, m

3. a. 1/5
   b. 1/100
   c. 1/4
   d. 1/10

4. a. $\frac{\text{Acres cruised}}{\text{Total tract acres}}$

   b. $\frac{\text{Plot size in acres}}{\text{Acres represented by each plot}} \times 100$

5. b, d, e

6. a. 3
   b. 7
   c. 1
   d. 5
   e. 4
   f. 2
   g. 6

7. a. 6
   b. 2
   c. 4
   d. 1
   e. 7
   f. 3
   g. 5

8. a. D
   b. A
   c. D
   d. A
   e. A
   f. D

9. Performance skills will be evaluated to the satisfaction of the instructor.

POINT SAMPLING
UNIT IX

TERMINAL OBJECTIVE

After completion of this unit, the student should be able to complete a point sample cruise layout to determine sawtimber volume. He should be able to select the correct basal area factor tool to use and perform the point sample measurements accurately. This knowledge will be evidenced through demonstration and by scoring eighty-five percent on the unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms associated with point sampling to the correct defintion.
2. Select from a list other names for point sampling.
3. Draw a diagram illustrating the principle of point sampling.
4. Identify the commonly used tools for point sampling.
5. Select from a list the three principles used to determine BAF.
6. Match the commonly used BAF's to the correct angle size.
7. State the rule to use PRF.
8. Match the commonly used BAF to the correct PRF.
9. Select from a list statements on the proper use of a prism.
10. Arrange in numerical order the steps taken to correct for slope when using the prism.
11. State the rules for determining the number of points to take in a point sample cruise.
12. Demonstrate the ability to:
    a. Complete a point sample cruise layout.
    b. Determine sawtimber volume by point sampling.

POINT SAMPLING
UNIT IX

SUGGESTED ACTIVITIES

I. Instructor:

- A. Provide students with objective sheet.
- B. Provide students with information and job sheets.
- C. Make transparency.
- D. Discuss terminal and specific objectives.
- E. Discuss information sheet.
- F. Demonstrate and discuss procedures outlined in the job sheets.
- G. Arrange field trips to allow students an opportunity to complete a point sample cruise layout and perform a cruise.
- H. Give test.

II. Students:

- A. Read objectives.
- B. Study information sheet.
- C. Demonstrate the ability to accomplish the procedures outlined in the job sheets.
- D. Participate in field trip.
- E. Take test.

INSTRUCTIONAL MATERIALS

I. Included in this unit:

- A. Objectives
- B. Information sheet
- C. Transparency master: TM 1–Use of the Prism

D. Job sheets

1. Job Sheet #1–Complete a Point Sample Cruise Layout

2. Job Sheet #2–Determine Sawtimber Volume by Point Sampling

E. Test

F. Answers to test

II. Reference–Avery, T. Eugene. *Forest Measurements.* New York: McGraw-Hill Book Co.

POINT SAMPLING
UNIT IX

INFORMATION SHEET

I. Terms and definitions

   A. Point sampling--A system of cruising using an angle gauge instrument

   B. Basal area (BA)--The area of a circle

   C. Basal area factor (BAF)--The numerical value of the angle gauge instrument that gives that basal area per acre for each tally tree

   D. Angle gauge--An instrument with a fixed angle the size needed for a particular BAF

   E. Wedge prism--A piece of glass ground to specification that bends the light rays for a particular angle

   F. Point--The reference point from which a point sample is taken

   G. Plot radius factor (PRF)--A numerical value multiplied times the tree diameter at DBH which gives the distance in feet the tree can be within and be tallied

   H. Ready-made volume factors--A table that gives an approximation of volume for point sampling

   I. Grid-interval--The distance between points

   J. Cruise line--A direction taken where a plot or point is sampled at specified grid intervals

II. Names for point sampling

   A. Bitterlich method

   B. Variable plot cruising

   C. Angle gauge cruising

   D. Relaskop cruising

   E. Multi-plot method

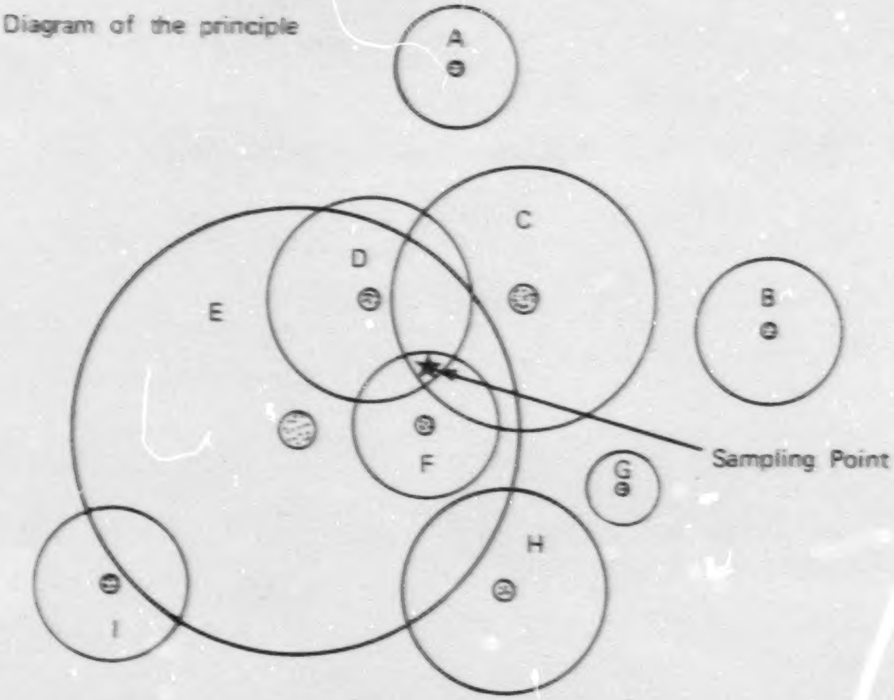
   F. Plotless cruising

   G. Wedge prism cruising

INFORMATION SHEET

III. Principle of point sampling--"Trees are selected as a sample on the basis of their sizes rather than the frequency of their appearance on a fixed plot sample. Trees are selected using a fixed angle instrument and represent a corresponding basal area per acre."

Diagram of the principle

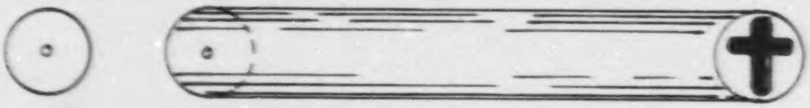


SOURCE: T.Eugene Avery, *Forest Measurements.*

(NOTE: C.D.E.F. are used. Tally trees (plots) must enclose sample point. Sampling point must be within imaginary plot to tally trees.)

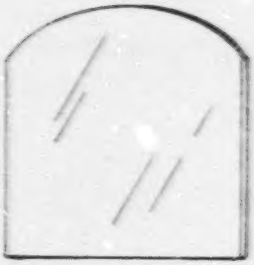
IV. Tools used for point sampling

A. Basal area angle gauge

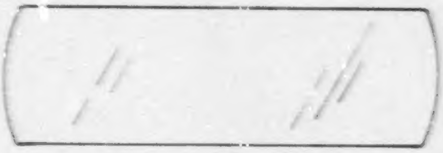


INFORMATION SHEET

B. Wedge prism

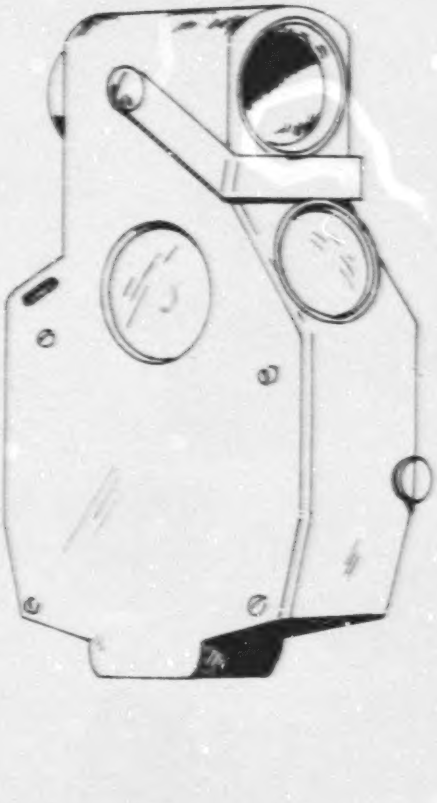


Square



Rectangular

C. Relaskop



INFORMATION SHEET

V. Principles used to determine BAF

   A. Tally an average of 7 trees per point for best representative measurement

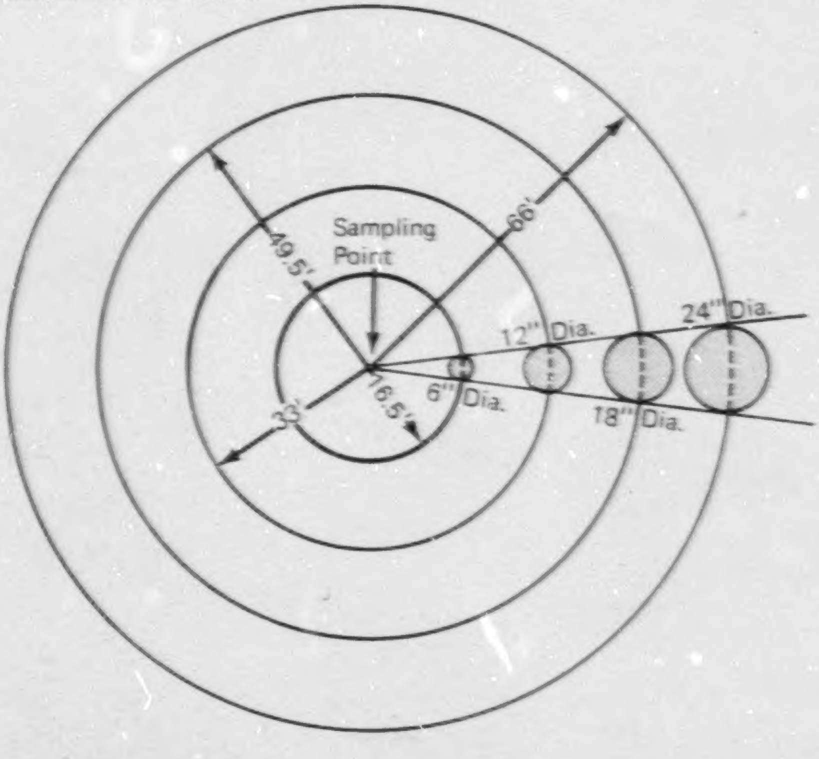
   B. Use small numerical value BAF tools for small trees and sparse numbers of trees

   C. Use larger numerical value BAF tools for large trees and dense numbers of trees

VI. Common basal area factors and angle sizes

	Basal Area Factors	Angle Sizes (minutes)
A.	5	73.66
B.	10	104.18
C.	20	147.34
D.	40	208.38

VII. Rule for plot radius factor (PRF)--PRF X DBH = Distance in feet the tree can be within and be tallied



INFORMATION SHEET

VIII. Table of PRF's for commonly used BAF's

	BAF	PRF
A.	5	3.889
B.	10	2.750
C.	20	1.944
D.	40	1.375

IX. Proper use of the prism (Transparency 1)

A. Hold at right angle to the eye, vertical and horizontal

B. Hold prism over the sample

C. Rotate prism horizontally to the angle of leaning trees

D. Measure distance to borderline trees and apply PRF

E. Correct for slope

X. Slope correction for the prism

A. Measure the slope with a Suunto clinometer

B. Place the prism on the top of the Suunto and hold both horizontal with the Suunto scale facing the observer

C. Rotate the Suunto until the scale reads the slope measurements

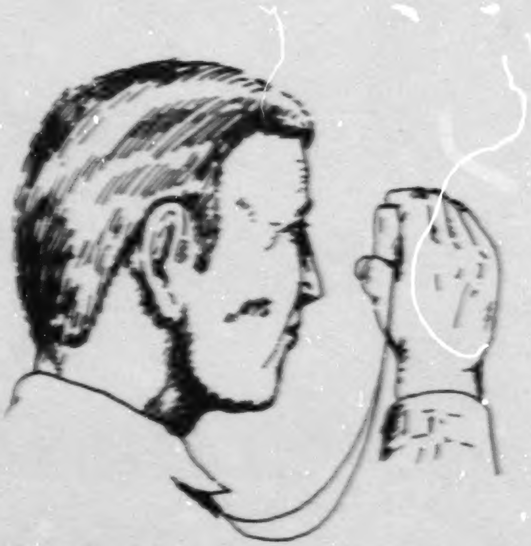
D. Read the tree through the prism while held in the above manner

XI. Rules for determining number of points to take in a point sample cruise

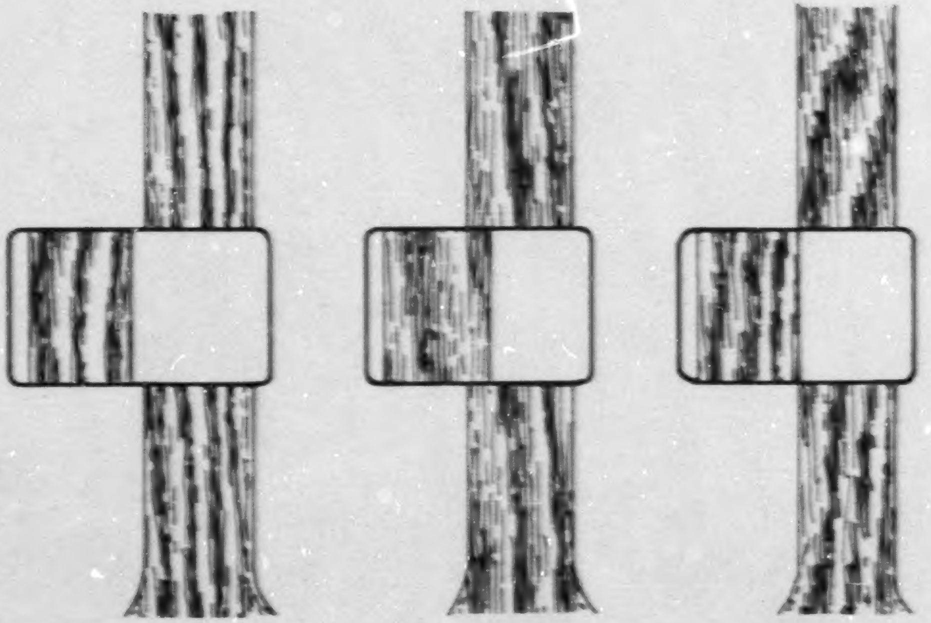
A. Never use less than 20 points per cruise

B. Use the same number of points as would be needed for a 10% cruise of 1/5 acre plots

Use of the Prism



Prism Offsets a Portion of the Tree Stem



Offset Complete
Don't Count
This Tree

Partial Offset
Do Count
This Tree

Borderline

POINT SAMPLING
UNIT IX

JOB SHEET #1--COMPLETE A POINT SAMPLE CRUISE LAYOUT

I. Tools and materials needed

A. Compass

B. Clipboard and pencil

II. Procedure

A. Complete the point sample cruise on 40 acres of timberland indicated by the instructor

B. Use 20 points for the total cruise

C. Determine the number of acres each point would represent

D. Determine the number of square chains in the representative acres found in the above step

E. Determine a square grid pattern by finding the square root of the square chains found in the above step or by finding a rectangle grid pattern of whole chains the nearest possible to a square shape

F. Locate points on the following 40 acre diagram using the above grid interval

G. Be sure to run cruise lines across drainage and topography

H. Be sure to locate first line and first point one-half the distance determined as the grid interval

I. Draw the following characteristics in the 40 acre diagram below:

1. Drainage and topography direction
2. Starting point
3. Cruise lines
4. Cruise direction
5. Grid interval for points

JOB SHEET #1

6. Grid interval for cruise lines

40 Acres

J. When completed, turn in to the instructor for evaluation

POINT SAMPLING
UNIT IX

JOB SHEET #2--DETERMINE SAWTIMBER VOLUME BY POINT SAMPLING

I. Tools and materials needed

   A. Compass

   B. BAF 10 prism

   C. Diameter tape

   D. Suunto clinometer

   E. 50' tape

   F. Clipboard and pencil

   G. Tally sheet

II. Procedure

   A. Locate first point according to the layout developed in Job Sheet #1 of this unit

   B. In a clockwise direction from the north, observe all trees of sawtimber size that can be seen from the point

   (NOTE: Apply the rules for the proper use of the prism.)

   C. Tally all sawtimber, count trees 9'.0"DBH and larger up to a 7.0" top DOB

   (NOTE: Apply the rules for U.S. Forest Service's merchantable heights.)

   D. Estimate DBH and heights and measure every tenth tree to develop skill in estimation

   E. Use dot-dash system of tally in the blanks provided on the tally sheet for appropriate DBH and merchantable heights

   F. For borderline trees, multiply the trees DBH times 2.75 to obtain the maximum distance in feet for tree count

   G. Apply the rules for slope correction on all trees on a slope of 10% or more from the point

      1. Measure the slope with a Suunto clinometer

      2. Place the prism on the top of the Suunto and hold both horizontal with the Suunto scale facing the observer

JOB SHEET #2

3. Rotate the Suunto until the scale reads the slope measurements

4. Read the tree through the prism while held in the above manner

H. When all points have been tallied, add the total trees round in each log height class

I. Obtain the volume for the tract using this ready-made volume table for point sampling

Merchantable Ht. (logs)	Volume Factor
1	4
1 1/2	6
2	8
2 1/2	10
3	12
3 1/2	13.5
4	15
4 1/2	18
5	21

J. Multiply the number of trees tallied in each log height class by the appropriate factor

K. Add the products obtained in the above step and apply to this formula:

$$\text{Volume per acre} = 100 \times \frac{\text{sum of products}}{\text{no. of points taken}}$$

40 acre tract sawtimber volume = ____________________ bd. ft.

JOB SHEET # 2

POINT SAMPLE TALLY SHEET

Date ______________________ CREW # ______________________

Pulpwood-H.T. (ft.)

Diameter	10	15	20	25	30	35	40		Point No.	Tally Count	Point No.	Tally Count
3.6 - 4.5												
4												
4.6 - 5.5												
5												
5.6 - 6.5												
6												
6.6 - 7.5												
7												
7.6 - 8.5												
8												
8.6 - 9.0												
9												

Sawtimber 16 ft. Logs

Diameter	1	1 1/2	2	2 1/2	3	3 1/2	4		Point No.	Tally Count	Point No.	Tally Count
9.1 - 10.9 10												
11.0 - 12.9 12												
13.0 - 14.9 14												
15.0 - 16.9 16												
17.0 - 18.9 18												
19.0 - 20.9 20												
21.0 - 22.9 22												
23.0 - 24.9 24												
25.0 - 26.9 26												
27.0 - 28.9 28												
29.0 - 30.9 30												
Write-in												

POINT SAMPLING
UNIT IX

TEST

1. Match the terms on the right to the correct definition.

_____a. A system of cruising using an angle gauge instrument

_____b. The area of a circle

_____c. The numerical value of the angle gauge instrument that gives the basal area per acre for each tally tree

_____d. An instrument with a fixed angle the size needed for a particular BAF

_____e. A piece of glass ground to specification that bends the light rays for a particular angle

_____f. The reference point from which a point sample is taken

_____g. A numerical value used to multiply times the tree diameter at DBH which gives the distance in feet the tree can be within and be tallied

_____h. A table that gives an approximation of volume for point sampling

_____i. The distance between points

_____j. A direction taken where a plot or point is sampled at specified grid intervals

1. Angle gauge
2. Plot radius factor
3. Cruise line
4. Basal area factor (BAF)
5. Point
6. Grid interval
7. Point sampling
8. Ready-made volume factors
9. Basal area (BA)
10. Wedge prism

2. Select from the list below other names used for point sampling by circling the correct letters.

a. Plot cruising

b. Bitterlich method

c. Variable plot cruising

d. Strip cruising

e. Relaskop cruising

f. Multi-plot method

g. Plotless cruising

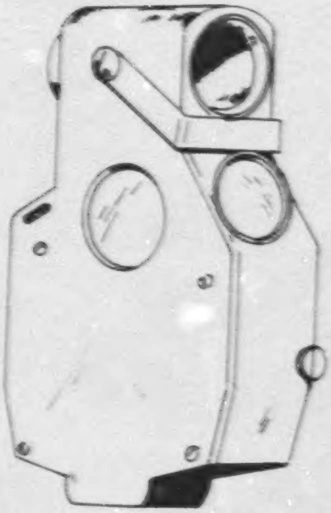
h. Area cruising

i. Wedge prism cruising

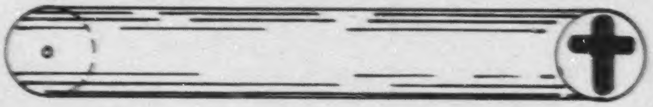
j. Angle gauge cruising

3. Draw a diagram illustrating the principle of point sampling.

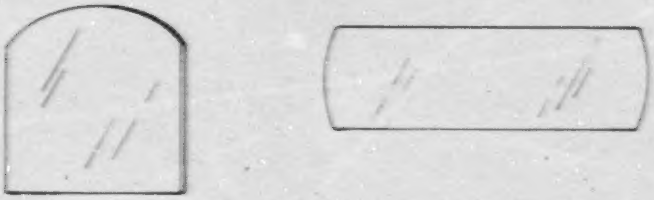
4. Identify the following tools used for point sampling.



a. ______________________________



b. ______________________________



c. ______________________________

5. Select from the list below three principles used to determine BAF. Place an "X" by the correct statements.

_____a. Tally an average of 7 trees per point for best representative measurement

_____b. Tally an average of 20 trees per point for best representative measurement

_____c. Use small BAF tools for small trees and sparse numbers of trees

_____d. Use larger BAF tools for large trees and dense numbers of trees

_____e. Use only 10 BAF

6. Match these commonly used BAF's to the correct angle size.

_____a.	5	1. 147.34 minutes
_____b.	10	2. 104.18 minutes
_____c.	20	3. 208.38 minutes
_____d.	40	4. 73.66 minutes

7. State the rule to use PRF.

8. Match these commonly used BAF's to the correct PRF's.

	BAF		PRF
a.	_____ 5	1.	1.944
b.	_____10	2.	1.375
c.	_____20	3.	3.889
d.	_____40	4.	2.750

9. Select from the list below statements on the proper use of a prism by circling the correct letters.

a. Hold at right angle to the eye, vertical and horizontal

b. Hold prism 25 inches from the eye

c. Hold prism over the sample

d. Rotate prism horizontally to the angle of leaning trees

e. Hold prism with the thin edge to the right

f. Measure distance to borderline trees and apply PRF

g. Correct for slope

10. Arrange in numerical order the steps taken to correct for slope when using the prism.

_____a. Rotate the Suunto until the scale reads the slope measurements

_____b. Measure the slope with a Suunto clinometer

_____c. Read the tree through the prism while held in the above manner

_____d. Place the prism on the top of the Suunto and hold both horizontal with the Suunto scale facing the observer

11. State the rules for determining the number of points to take in a point sample cruise.

    a.

    b.

12. Demonstrate the ability to:

    a. Complete a point sample cruise layout.

    b. Determine sawtimber volume by point sampling.

    (NOTE: If these have not been accomplished prior to the test, ask the instructor when the above activites should be completed.)

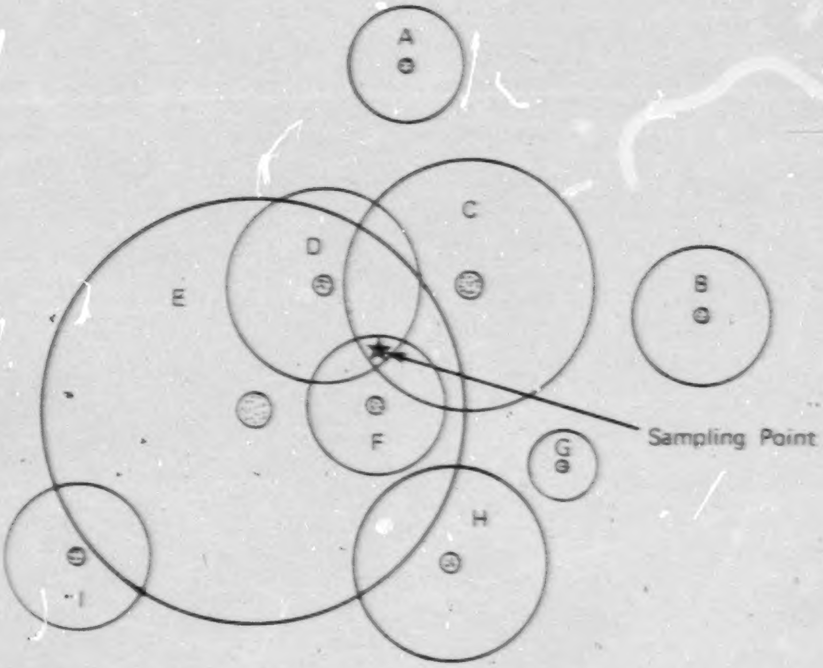
POINT SAMPLING
UNIT IX

ANSWERS TO TEST

1. a. 7
   b. 9
   c. 4
   d. 1
   e. 10
   f. 5
   g. 2
   h. 8
   i. 6
   j. 3

2. b, c, e, f, g, i, j

3.


A
C
D
E
B
Sampling Point
F
G
H
I

4. a. Relaskop
   b. Basal area angle gauge
   c. Wedge prism

5. a, c, d

6. a. 4
   b. 2
   c. 1
   d. 3

7. PRF X DBH = Distance in feet the tree can be within and be tallied

8. a. 3
   b. 4
   c. 1
   d. 2

9. a, c, d, f, g

10. a. 3
    b. 1
    c. 4
    d. 2

11. a. Never use less than 20 points per cruise
    b. Use the same number of points as would be needed for a 10% cruise of 1/5 acre plots

12. Performance skills will be evaluated to the satisfaction of the instructor.

THE SIVICULTURAL SYSTEMS
UNIT I

TERMINAL OBJECTIVE

After completion of this unit, the student should be able to classify trees into Grosenbaugh's tree classes. He should be able to name characteristics used in selecting harvest trees and types of natural and artificial reproduction methods. He should also be able to interpret the selection method. This knowledge will be evidenced through demonstration and by scoring eighty-five percent on the unit test.

SPECIFIC OBJECTIVES

1. Match terms associated with the sivicultural systems to the correct definition.
2. Name the types of reproduction methods under the classes of natural and artificial reproduction methods.
3. Arrange in numerical order the classes of reproduction methods.
4. Select from a list of statements the two principles of the selection method.
5. Select from a list the types of modifications of the selection method.
6. Name the four characteristics used in selecting harvest trees in the selection method when given a list of the descriptive factors.
7. Match Grosenbaugh's tree classes with the correct definition.
8. Demonstrate the ability to classify trees according to Grosenbaugh's tree classification system.

THE SIVICULTURAL SYSTEMS
UNIT I

SUGGESTED ACTIVITIES

I. Instructor:

- A. Provide students with objective sheet.
- B. Provide students with information and job sheets.
- C. Make transparency.
- D. Discuss terminal and specific objectives.
- E. Discuss information sheet.
- F. Demonstrate and discuss procedure outlined in the job sheet.
- G. Arrange field trips to allow students an opportunity to classify trees.
- H. Give test.

II. Students:

- A. Read objectives.
- B. Study information sheet.
- C. Demonstrate the ability to accomplish the procedure outlined in the job sheet.
- D. Participate in field trip.
- E. Take test.

INSTRUCTIONAL MATERIALS

I. Included in this unit:

- A. Objectives
- B. Information sheet
- C. Transparency master: TM 1–Grosenbaugh's Classification System
- D. Job Sheet #1–Classify Trees by Grosenbaugh's System

E. Test

F. Answers to test

II. Reference—Hawley, Ralph C. and David M. Smith. *The Practice of Siviculture.* New York; Wiley and Sons.

THE SIVICULTURAL SYSTEMS
UNIT I

INFORMATION SHEET

I. Terms and definitions

A. Siviculture--Art of producing and tending a forest

B. Sivicultural system--Plan of sivicultural treatment during the life of a stand or forest

C. Reproduction--Seedlings of a forest; generally used as regeneration

D. Regeneration--Process of forming a new forest; used as reproduction

E. Reproduction method--Procedure by which a stand or forest is renewed

F. Sprout--Plant from vegetative origin rather than from flower and seed

G. High forest--Regenerating stands from seed

H. Low forest--Regenerating stands from sprouts

I. Even aged--Stands of trees of approximately the same age

J. Uneven aged--Stands of trees of wide ranges of ages

K. Clearcutting--Removal of the entire stand of trees at the same time and regenerated artifically or naturally

L. Seed tree--Removal of an entire stand except for approximately one-tenth of the trees left for seeding

M. Shelterwood--Removal of a stand of trees in a series of cuttings for the purpose of seeding and protection

N. Selection--Removal of mature trees at repeated intervals

O. Coppice--Cutting with dependence on sprouts for regeneration

P. Coppice with standards--Cutting with a combination of seed trees and sprouts for regeneration

Q. Rotation--Period of time trees are grown based on economic factors

R. Cutting cycle--Period of time between visits to a stand of timber for cutting

INFORMATION SHEET

S. Thinning--Cuttings made in young stands to stimulate growth of the trees left

T. Single-tree selection--Timber marking and harvest based on the merits of individual trees in a stand

U. Group selection--Cuttings of small groups of trees as a unit of uneven age stands

V. Strip selection--Arrangement and cutting of strips of trees of even age in an uneven age stand

W. Continuous forest--Selection cutting of trees with no rotation age but based on the economic merits of each individual tree

II. Reproduction methods

- A. Natural
  - 1. Seed fall
  - 2. Sprouts
- B. Artificial
  - 1. Seeding
  - 2. Planting

III. Classes of reproduction methods (sivicultural systems)

- A. High forest
  - 1. Even aged
    - a. Clearcutting
    - b. Seed tree
    - c. Shelterwood
  - 2. Uneven aged--Selection
- B. Low Forest
  - 1. Coppice
  - 2. Coppice with standards

INFORMATION SHEET

IV. Principles of the selection method

- A. Principle one–Economically mature trees of rotation age are harvested periodically in cutting cycles and the openings left are seeded in by the surrounding trees
- B. Principle two--During the harvest cut of mature trees, the younger age classes are thinned

V. Modifications of the selection method

- A. Single-tree
- B. Group
- C. Strip
- D. Continuous forest

VI. Characteristics of harvest trees of the selection method

- A. Age
    - 1. Rotation age
    - 2. Diameter limit
- B. Merchantability
    - 1. Product specifications
    - 2. Market availability
- C. Health
    - 1. Insect or disease damage
    - 2. Reduced growth
- D. Capacity for growth
    - 1. Low quality
    - 2. Low volume potential

INFORMATION SHEET

VII. Grosenbaugh's definitions of tree classes

A. Grown-up Tree of salable dimensions whose salability depends on other factors

1. Payer--Salable tree whose stumpage has a current market value greater than zero

a. Grower--Payer whose expectancy of living for the next 10 years is at least 9/10 while its expected ratio of

$$\frac{\text{stumpage value 10 years hence}}{\text{stumpage value now}}$$

will be at least 4/3 if it survives and is given adequate space

b. Cipher--Payer whose expectancy of living for the next 10-year period exceeds 9/10 but which does not have an expected ratio of

$$\frac{\text{stumpage value 10 years hence}}{\text{stumpage value now}}$$

equal to at least 4/3 and which does not compete with any grower, doll, or cub

(NOTE: Some people call such trees financially mature.)

c. Topper--Payer similar to a cipher but overtopping a doll or cub

d. Slower--Least potentially productive of several payers competing in inadequate growing space

(NOTE: It should be cut in thinning.)

e. Risker--Payer who expectancy of living for the next 10-year period is less than 9/10

(NOTE: It should be cut to salvage potential loss through mortality.)

f. Killer--Payer infested with contagious pathogens

2. Crud--Grown-up which cannot be sold because of species, form, knots, rot, insects, or other defects

a. Null--Crud not competing with any grower, doll, or cub

b. Cork--Crud overtopping a doll or cub

c. Pang--Crud seriously competing with a grower or harboring contagious pathogens

INFORMATION SHEET

B. Deb–Tree at least 4 1/2 feet tall but smaller than a grown-up

  1. Doll–Desirable deb which is a potential grower, given adequate space and time

  2. Drip–Undesirable deb which is unlikely to become a grower, even though given space and time, but which is not interfering with a doll or cub

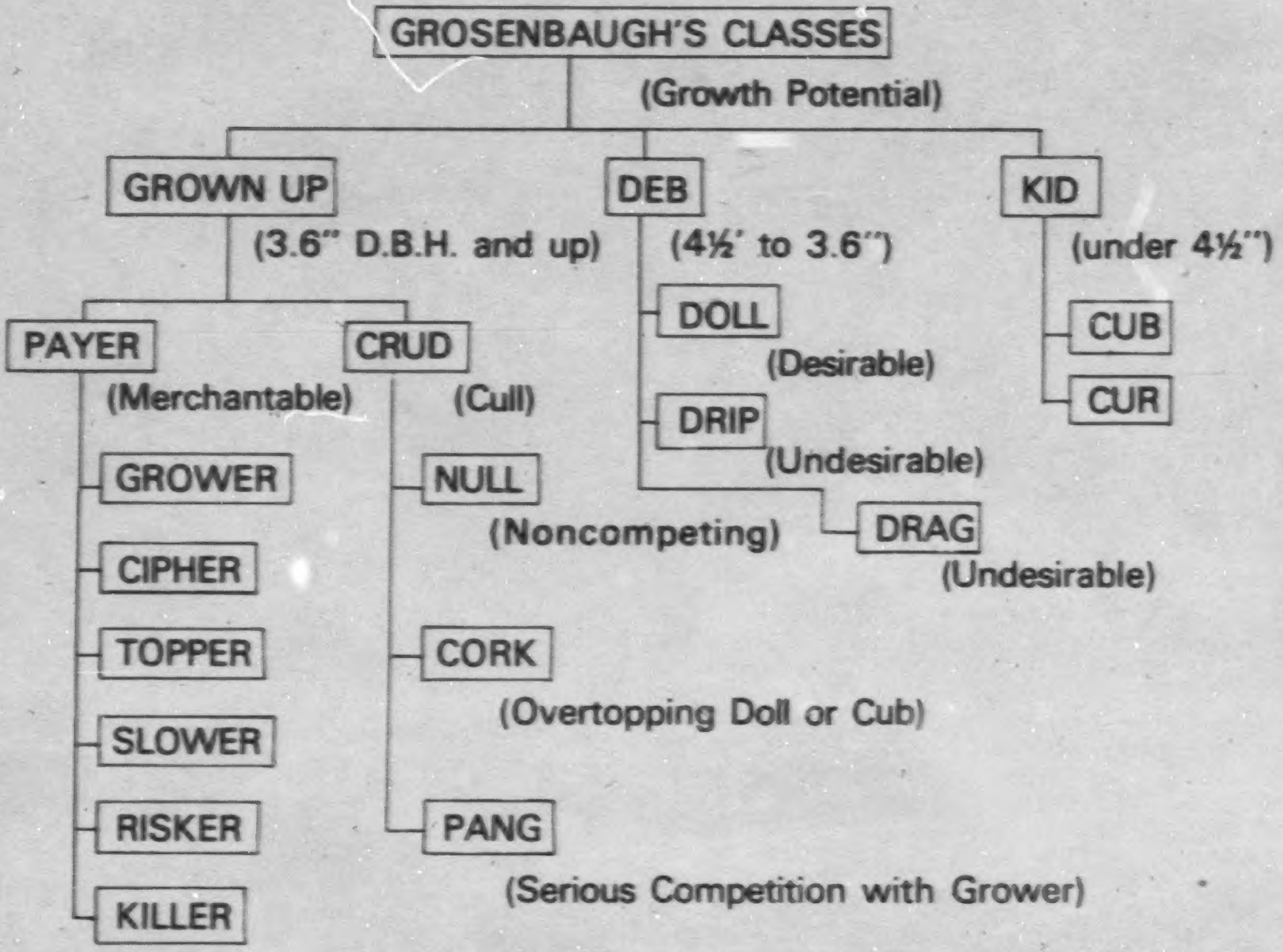
  3. Drag–Undesirable deb which is interfering with a doll or cub

C. Kid–Tree seedling less than 4 1/2 feet tall

  1. Cub–Desirable kid which is a potential doll

  2. Cur–Undesirable kid which will probably become a drip or drag

Grosenbaugh's Classification System



- GROSENBAUGH'S CLASSES
  (Growth Potential)
  - GROWN UP
    (3.6" D.B.H. and up)
    - PAYER
      (Merchantable)
      - GROWER
      - CIPHER
      - TOPPER
      - SLOWER
      - RISKER
      - KILLER
    - CRUD
      (Cull)
      - NULL
        (Noncompeting)
      - CORK
        (Overtopping Doll or Cub)
      - PANG
        (Serious Competition with Grower)
  - DEB
    (4½' to 3.6")
    - DOLL
      (Desirable)
    - DRIP
      (Undesirable)
    - DRAG
      (Undesirable)
  - KID
    (under 4½")
    - CUB
    - CUR

THE SIVICULTURAL SYSTEMS
UNIT I

JOB SHEET #1--CLASSIFY TREES BY GROSENBAUGH'S SYSTEM

I. Tools and materials needed

  A. Diameter tape

  B. Increment borer

  C. Clipboard

  D. Tally sheet

  E. Schneider's growth graph

  F. Grosenbaugh's tree classes sheet

  G. One-fifth acre indicated by the instructor

  H. Pencil

II. Procedure

  A. On the area indicated by the instructor, classify each living tree into the classes by Grosenbaugh

  (NOTE: Use the information sheet if necessary.)

  B. For each tree, identify in which major class it belongs according to size such as kid, deb, or grown-up

  C. For the grown-up major class, identify in which value class it belongs such as payer or crud

  D. For the payer and crud classes, start at the bottom class and go up until the tree fits the definition

  (NOTE: Use TM 1 as a guide.)

  E. For a decision between cipher and grower, use the attached Schneider's growth graph

    1. Bore into the tree until you have entered into the solid wood of the tree for 2 inches

    (NOTE: See the instructor for use of the increment borer if you do not know the proper way to use it at this point.)

JOB SHEET #1

2. Count the number of annual rings found in the last inch of wood formed on the tree

   (NOTE: Use the inside scale of the diameter tape for one inch measure.)

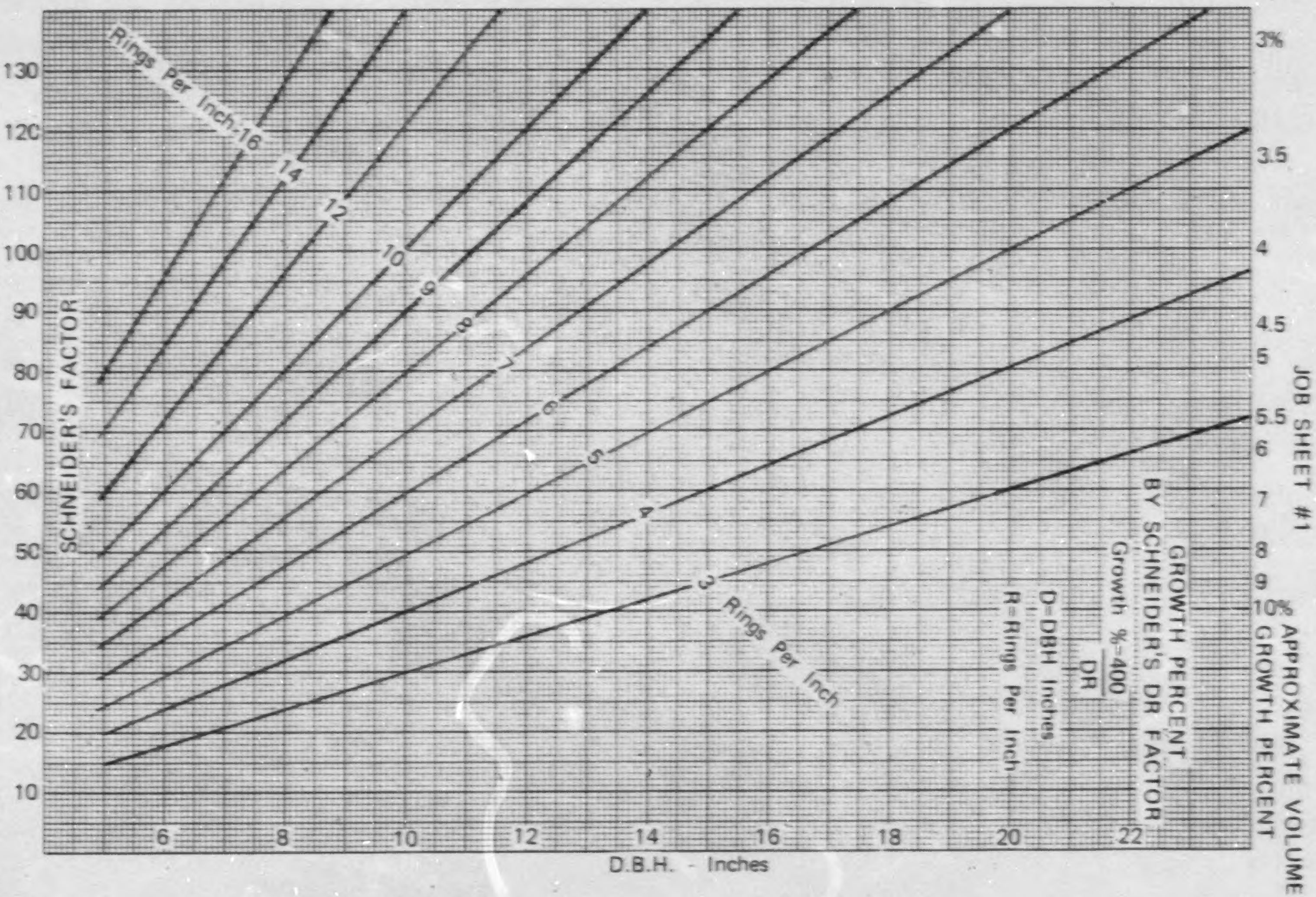
3. Measure the diameter

4. Read the corresponding growth percent and DR (D=DBH inches and R=rings per inch) count on the graph

   (NOTE: If DR is more than 133 and growth less than 3%, the tree is a cipher. If DR is less than 133 and growth 3% or more, the tree is a grower.)

F. Tally each tree on the attached tally sheet in the appropriate blanks using the dot-dash system of tally

G. When all trees have been tallied, turn in to the instructor for evaluation


SCHNEIDER'S FACTOR
10
20
30
40
50
60
70
80
90
100
110
120
130
Rings Per Inch-16
14
12
10
9
8
7
6
5
4
3
Rings Per Inch
6
8
10
12
14
16
18
20
22
D.B.H. - Inches
3%
3.5
4
4.5
5
5.5
6
7
8
9
10%
GROWTH PERCENT BY SCHNEIDER'S DR FACTOR
Growth % = 400/DR
D=DBH Inches
R=Rings Per Inch
APPROXIMATE VOLUME GROWTH PERCENT
JOB SHEET #1

THE SIVICULTURAL SYSTEMS
UNIT I

TEST

1. Match the terms on the right to the correct definition.

______ a. Art of producing and tending a forest

______ b. Plan of sivicultural treatment during the life of a stand or forest

______ c. Seedlings of a forest; generally used as regeneration

______ d. Process of forming a new forest; used as reproduction

______ e. Procedure by which a stand or forest is renewed

______ f. Regenerating stands from seed

______ g. Regenrating stands from sprouts

______ h. Plant from vegetative origin rather than from flower and seed

______ i. Stands of trees of approximately of the same age

______ j. Stands of trees of wide ranges of ages

______ k. Removal of the entire stand of trees at the same time and regenerated artifically or naturally

______ l. Removal of an entire stand except for approximately one-tenth of the trees left for seeding

1. Regeneration
2. Clearcutting
3. Low forest
4. Coppice
5. Even aged
6. Rotation
7. Reproduction method
8. Cutting cycle
9. Reproduction
10. Uneven aged
11. Siviculture
12. Strip selection
13. Single-tree selection
14. Sprout
15. Thinning
16. Coppice with standards
17. Seed tree
18. Sivicultural system
19. Selection

_____m. Removal of a stand of trees in a series of cuttings for the purpose of seeding and protection

_____n. Removal of mature trees at repeated intervals

_____o. Cutting with dependence on sprouts for regeneration

_____p. Cutting with a combination of seed trees and sprouts for regeneration

_____q. Period of time trees are grown based on economic factors

_____r. Period of time between visits to a stand of timber for cutting

_____s. Cuttings made in young stands to stimulate growth of the trees left

_____t. Timber marking and harvest based on the merits of individual trees in a stand

_____u. Cuttings of small groups of trees as a unit of uneven age stands

_____v. Arrangement and cutting of strips of trees of even age in an uneven age stand

_____w. Selection cutting of trees with no rotation age but based on the economic merits of each individual tree

20. High forest

21. Shelterwood

22. Group selection

23. Continuous forest

2. Name the types of reproduction methods under the classes of natural and artificial reproduction methods.

a. Natural	b. Artificial
1)	1)
2)	2)

3. Arrange in numerical order the classes of reproduction methods by writing the correct word(s) in the blanks provided.

   a. High forest
      1) ____________
         a) ____________
         b) ____________
         c) ____________
      2) ____________-____________
   b. Low forest
      1) ____________
      2) ____________

   Selection
   Clearcutting
   Shelterwood
   Coppice
   Seed tree
   Coppice with standards
   Even aged
   Uneven aged

4. Select from the list below the two principles of the selection method by placing an "X" in the blank provided.

   ______a. During the harvest cut of mature trees, the younger age classes are thinned.

   ______b. Each area that reached the rotation age is clearcut for harvest.

   ______c. Economically mature trees of rotation age are harvested periodically in cutting cycles and the openings left are seeded in by the surrounding trees.

   ______d. Seed trees are left to regenerate the area while all other trees are removed.

5. Select from the list below the four types of modifications of the selection method.

   ______a. Clearcut
   ______b. Shelterwood
   ______c. Continuous forest
   ______d. Single-tree,
   ______e. Group
   ______f. Seed tree
   ______g. Strip
   ______h. Coppice

6. Name the four main characteristics used in selecting harvest trees in the selection method.

   a.

   b.

   c.

   d.

7. Match Grosenbaugh's tree classes with the correct definitions.

_____a. Tree of salable dimensions whose salability depends on other factors

_____b. Payer whose expectancy of living for the next 10 years is at least 9/10 while its expected ratio of stumpage value 10 years hence/stumpage value now will be at least 4/3 if it survives and is given adequate space

_____c. Least potentially productive of several payers competing in inadequate growing space

_____d. Undesirable kid which will probably become a drip or drag

_____e. Payer whose expectancy of living for the next 10-year period exceeds 9/10, but which does not have an expected ratio of stumpage value 10 years hence/stumpage value now equal to at least 4/3 and which does not compete with any grower, doll, or cub

_____f. Salable tree whose stumpage has a current market value greater than zero

_____g. Tree seedling less than 4 1/2 feet tall

_____h. Undesirable bed which is interfering with a doll or cub

_____i. Payer whose expectancy of living for the next 10-year period is less than 9/10

_____j. Tree at least 4 1/2 feet tall but smaller than a grown-up

_____k. Crud overtopping a doll or cub

_____l. Desirable deb which is a potential grower, given adequate space and time

1. Cork
2. Payer
3. Grower
4. Cipher
5. Topper
6. Slower
7. Risker
8. Killer
9. Crud
10. Null
11. Grown-up
12. Pang
13. Deb
14. Doll
15. Drip
16. Drag
17. Kid
18. Cub
19. Cur

_____m. Payer similar to a cipher but overtopping a doll or cub

_____n. Desirable kid which is a potential doll

_____o. Crud seriously competing with a grower or harboring contagious pathogens

_____p. Undesirable deb which is unlikely to become a grower, even though given space and time, but which is not interfering with a doll or cub

_____q. Crud not competing with any grower, doll, or cub

_____r. Grown-up which cannot be sold because of species, form, knots, rot, insects, or other defects

_____s. Payer infested with contagious pathogens

8. Demonstrate the ability to classify trees according to Grosenbaugh's tree classification system.

(NOTE: If this has not been accomplished prior to the test, ask the instructor when the above activity should be completed.)

THE SIVICULTURAL SYSTEMS
UNIT I

ANSWERS TO TEST

1. a. 11
   b. 18
   c. 9
   d. 1
   e. 7
   f. 20
   g. 3
   h. 14
   i. 5
   j. 10
   k. 2
   l. 17
   m. 21
   n. 19
   o. 4
   p. 16
   q. 6
   r. 8
   s. 15
   t. 13
   u. 22
   v. 12
   w. 23

2. a. Natural
      1) Seed fall
      2) Sprouts
   b. Artificial
      1) Seeding
      2) Planting

3. a. High forest
      1) Even aged
         a) Clearcutting
         b) Seed tree
         c) Shelterwood
      2) Uneven aged–Selection
   b. Low forest
      1) Coppice
      2) Coppice with standards

4. a,c

5. c, d, e, g

6. a. Age
   b. Merchantability
   c. Health
   d. Capacity for growth

7. a. 11
   b. 3
   c. 6
   d. 19
   e. 4
   f. 2
   g. 17
   h. 16
   i. 7
   j. 13
   k. 1
   l. 14
   m. 5
   n. 18
   o. 12
   p. 15
   q. 10
   r. 9
   s. 8

8. Performance skill will be evaluated to the satisfaction of the instructor

MARKING TIMBER IN THINNINGS
UNIT II

TERMINAL OBJECTIVE

After completion of this unit, the student should be able to select methods of marking timber, factors for crown spacing, and reasons for removing diseased trees. He should also be able to mark timber to be harvested in a thinning operation. This knowledge will be evidenced through demonstration and by scoring eighty-five percent on the unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms associated with marking timber in thinnings to the correct definition.
2. Select from a list of statements the sivicultural and thinning principles applied to thinning.
3. Match the methods of thinning to the correct definition.
4. Select from a list the most commonly used methods of marking timber.
5. Arrange in numerical order the priority of marking trees in a thinning.
6. Select from a list the correct factors for crown spacing.
7. Select from a list three reasons for removing diseased trees and snags.
8. Demonstrate the ability to mark timber.

MARKING TIMBER IN THINNINGS
UNIT II

SUGGESTED ACTIVITIES

I. Instructor:

  A. Provide students with objective sheet.

  B. Provide students with information and job sheets.

  C. Discuss terminal and specific objectives.

  D. Discuss information sheet.

  E. Demonstrate and discuss procedure outlined in the job sheet.

  F. Arrange field trips to allow students an opportunity to mark timber.

  G. Give test.

II. Student:

  A. Read objectives.

  B. Study information sheet.

  C. Demonstrate the ability to accomplish procedure outlined in the job sheet.

  D. Participate in field trip.

  E. Take test.

INSTRUCTIONAL MATERIALS

I. Included in this unit:

  A. Objectives

  B. Information sheet

  C. Job Sheet #1–Mark Timber

  D. Test

  E. Answers to test

II. Reference–Hawley, Ralph C. and David M. Smith. *The Practice of Siviculture.* New York: Wiley and Sons.

MARKING TIMBER IN THINNINGS
UNIT II

INFORMATION SHEET

I. Terms and definitions

   A. Thinning--Cutting in young stands to stimulate the growth of the trees left

   B. Marking timber--Method used to indicate trees to be cut.

   C. Growth--Production of a stand including increment of wood and ingrowth of small trees

   D. Snag--Any damaged tree such as a dead, dying, or broken topped tree

   E. Crown--That part of the tree consisting of leaves, twigs, flowers, and fruit

   F. Stand vigor--The growth potential of a group of trees

   G. Site--An area of land having the same potential to produce trees and growth

   H. Fire risk--A source of ignition of fires such as a snag that could contribute sparks to the wind when on fire

II. Sivicultural and thinning principles

   A. Sivicultural principle--"A given area of timberland produces a given amount of growth that flucuates very little from one year to the next, and man can only influence which plants receive that growth."

   B. Thinning principles based on the sivicultural principle

      1. "Redistribute the growth potential to optimum advantage."

      2. "Utilize all possible, merchantable material produced by the stand."

III. Methods of thinning

   A. Low thinning--Cutting the overtopped and intermediate crown classes first

   B. Crown thinning--Removing a portion of codominants and dominants to favor the remaining codominants and dominants

   C. Selection thinning--Cutting the upper crown classes in order to favor the lower crown classes

INFORMATION SHEET

D. Mechanical thinning–Cutting trees regardless of crown position by rows or by spacing of stems

IV. Methods of marking timber

A. Painting

(NOTE: This is most commonly used.)

B. Ax blazes

C. Flagging ribbon

D. Lime sock

V. Priority of trees to mark

A. Dead trees

B. Dying trees

C. Broken topped trees

D. Leaning trees

E. Poor bole form trees

F. Crown competitors

VI. Factors for crown spacing

A. Stand age

(NOTE: Use stand age when crowns are in rigorous competition.)

B. Stand vigor

(NOTE: This refers to growth potential and site.)

C. Site quality

(NOTE: There is more crown spacing on a good site.)

D. Crown quality

(NOTE: High quality crown requires more space.)

E. Cutting cycle

(NOTE: The cutting cycle is the period of time between cutting. Estimate space to leave.)

INFORMATION SHEET

VII. Reasons for removing diseased trees and snags

- A. Saves merchantable volume
- B. Prevents and controls disease
- C. Reduces fire risk

MARKING TIMBER IN THINNINGS
UNIT II

JOB SHEET #1--MARK TIMBER

I. Tools and materials needed

   A. Diameter tape

   B. Suunto clinometer

   C. 50' tape

   D. Marking gun and paint

   E. Area of trees to thin as indicated by the instructor

   F. Clipboard and pencil

II. Procedure

   A. Mark and tally pine trees to be removed in thinning

   B. Select trees according to the priority of trees to mark:

      1. Dead trees (those with usable material)

      2. Dying trees

      3. Broken topped trees

      4. Leaning trees

      5. Poor bole form (sweep, crook, or forked)

      6. Crown competitors

   C. Of the crown competitors, select trees to thin using the low thinning method

   D. Plan on a cutting cycle of five years

   E. Ask the instructor to demonstrate how to identify and use the factors for crown spacing if he has not done so at this point

   F. Pick the leave trees in the dominant and codominant classes first

   G. Thin as necessary the trees left using the instructions given

JOB SHEET #1

H. Mark thinning trees with paint

I. Mark sawtimber with one spot of paint six feet from the ground and two spots at the ground line

J. Mark pulpwood trees with one spot of paint six feet from the ground and one spot of paint at the ground line

(NOTE: The paint spots at head level are for visibility. The paint spots on the stumps leave a record of marked and nonmarked trees after the cutting is completed.)

K. Mark all paint spots facing the same direction on the selected trees

L. Tally trees by diameter and height on the attached tally form; use the standard diameter and height specifications used previously in cruising job sheets

M. Ask the instructor to evaluate your marking procedure

N. When completed with marking and tallying the area designated, turn in the completed tally sheet to the instructor for evaluation

JOB SHEET #1

Form No. [illegible]
Tract________________________________
Owner________________________________
Marker________________________________
Date________________________________

TIMBER MARKETING TALLY SHEET

FORESTRY DIVISION
STATE DEPARTMENT OF AGRICULTURE
122 CAPITOL BUILDING
OKLAHOMA CITY, OKLA. 73105

DATE	TOTAL TALLY

POST & POLES

______% TREE TALLY

DIA.		TOTAL MERCHANTABLE HT. — FEET																		
		6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42
2.5 TO 3.5	3																			
3.6 TO 4.5	4																			
4.6 TO 5.5	5																			
5.6 TO 6.5	6																			
6.6 TO 7.5	7																			
7.6 TO 8.5	8																			
8.6 TO 9.5	9																			

SAW TIMBER—100% Tally 16 Ft. Logs

Sound Defective

DIA.		½ 8' – 15'	1 16' – 20'	1½ 21' – 27'	2 28' – 37'	2½ 38' – 45'	3 46' – 53'	3½ 54' – 60'	4 61' – 68'	LARGE TREES DIA.	HT.	S D
9.0 – 10.9	10											
11.0 – 12.9	12											
13.0 – 14.9	14											
15.0 – 16.9	16											
17.0 – 18.9	18											
19.0 – 20.9	20											
21.0 – 22.9	22											
23.0 – 24.9	24											
25.0 – 26.9	26											
27.0 – 28.9	28											
29.0 – 32.9	30											

MARKING TIMBER IN THINNINGS
UNIT II

TEST

1. Match the terms on the right to the correct definition.

_____a. Cutting in young stands to stimulate the growth of the trees left

_____b. Method used to indicate trees to be cut

_____c. Production of a stand including increment of wood and ingrowth of small trees

_____d. Any damaged tree such as a dead, dying, or broken topped tree

_____e. That part of the tree consisting of leaves, twigs, flowers, and fruit

_____f. The growth potential of a group of trees

_____g. An area of land having the same potential to produce trees and growth

_____h. A source of ignition of fires such as a snag that could contribute sparks to the wind when on fire

1. Site
2. Stand vigor
3. Fire risk
4. Marking timber
5. Crown
6. Snag
7. Thinning
8. Growth

2. Select from the list below the principles of siviculture and thinning by placing an "X" in the proper blanks.

_____a. "Man changes the growth of timber land."

_____b. "A given area of timber land produces a given amount of growth that flucuates very little from one year to the next, and man can only influence which plants receive that growth."

_____c. "Redistribute the growth potential to optimum advantage."

_____d. "Cut so that reproduction will readily find room to grow."

_____e. "Utilize all possible merchantable material produced by the stand."

3. Match the methods of thinning to the correct definition.

_____a. Removing a portion of codominants and dominants to favor the remaining codominants and dominants

_____b. Cutting the overtopped and intermediate crown classes first

_____c. Cutting trees regardless of crown position by rows or by spacing of stems

_____d. Cutting the upper crown classes in order to favor the lower crown classes

1. Low thinning
2. Crown thinning
3. Selection thinning
4. Mechanical thinning

4. Select from the list below the most commonly used methods of marking timber.

_____a. Lime sock

_____b. Talc powder

_____c. Flagging ribbon

_____d. Painting

_____e. Grease stick

_____f. Ax blazes

5. Arrange in numerical order the priority of marking trees in a thinning.

_____a. Broken topped trees

_____b. Crown competitors

_____c. Leaning trees

_____d. Dead trees

_____e. Poor bole form trees

_____f. Dying trees

6. Select from the list below the correct factors for crown spacing.

_____a. Tree species
_____b. Stand age
_____c. Stand vigor
_____d. Tree diameter
_____e. Site quality
_____f. Bole length
_____g. Crown quality
_____h. Cutting cycle

7. Select from the list below three reasons for removing diseased trees and snags.

_____a. Reduces fire risk
_____b. Increases human safety
_____c. Prevents and controls disease
_____d. Saves merchantable volume
_____e. Reduces eyesore

8. Demonstrate the ability to mark timber.

(NOTE: If this has not been accomplished prior to the test, ask the instructor when the above activity should be completed.)

MARKING TIMBER IN THINNINGS
UNIT II

ANSWERS TO TEST

1. a. 7
   b. 4
   c. 8
   d. 6
   e. 5
   f. 2
   g. 1
   h. 3
2. b, c, e
3. a. 2
   b. 1
   c. 4
   d. 3
4. a, c, d, f
5. a. 3
   b. 6
   c. 4
   d. 1
   e. 5
   f. 2
6. b, c, e, g, h
7. a, c, d
8. Performance skills will be evaluated to the satisfaction of the instructor.

SEEDING AND PLANTING
UNIT III

TERMINAL OBJECTIVE

After completion of this unit, the student should be able to describe ways to store seedlings and classifications of planting stock. He should also be able to select from a list factors for spacing seedlings, identify tools used in hand planting, arrange in order the procedure for seed treatment, and complete a seeding or planting project. This knowledge will be evidenced through demonstration and by scoring eighty-five percent on the unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms associated with seeding and planting to the correct definition.
2. Name two sources of seed for seeding and planting.
3. List two sources of seedling production in Oklahoma.
4. List two types of seedling packaging.
5. Select from a list the correct procedure for the care of seedlings in transport.
6. Describe ways to store seedlings for both short and long storage.
7. Describe classifications of planting stock.
8. Select from a list the factors for spacing seedlings.
9. Identify the tools used in hand planting.
10. Select from a list the four methods of hand planting seedlings.
11. Describe the time to collect shortleaf pine cones.
12. Arrange in order the procedure for seed treatment before seeding.
13. Match the types of seeding applications to the methods of seeding.
14. Demonstrate the ability to hand plant seedlings.

SEEDING AND PLANTING
UNIT III

SUGGESTED ACTIVITIES

I. Instructor:

   A. Provide student with objective sheet.

   B. Provide student with information and job sheets.

   C. Discuss terminal and specific objectives.

   D. Discuss information sheet.

   E. Discuss the procedure outlined in the job sheet.

   F. Arrange field trips to allow students an opportunity to plant seedlings.

   G. Give test.

II. Students:

   A. Read objectives.

   B. Study information sheet.

   C. Demonstrate the ability to accomplish the procedure outlined in the job sheet.

   E. Participate in field trip.

   F. Take test.

INSTRUCTIONAL MATERIALS

I. Included in this unit:

   A. Objectives

   B. Information sheet

   C. Transparency masters

      1. TM #1–Classification of Planting Stock

      2. TM #2–Hand Planting Tools

D. Job Sheet #1--Hand Plant Seedlings

E. Test

F. Answers to test

II. Reference--Hawley, Ralph C. and David M. Smith. *The Practice of Siviculture.* New York: Wiley and Sons.

SEEDING AND PLANTING
UNIT III

INFORMATION SHEET

I. Terms and definitions

A. Seeding--A method of artificial regeneration by direct seeding of forest tree seed

B. Planting--A method of artificial regeneration by planting forest tree seedlings

C. Seed orchards--A group of trees, natural or artificially created, managed for the purpose of providing seed

D. Superior tree--A native tree that has genetic characteristics of fast growth, high quality wood, and resistance to disease and insects

(NOTE: These trees produce scion wood and seed which are collected to provide clones and seed orchards.)

E. Scion--The growing terminals on twigs cut from the superior trees for grafting on common root stock

F. Clone--A growing tree developed from the grafting of scions on root stock

G. Root stock--The root system from an average seedling from a nursery

H. Heeling-in--The temporary planting of seedlings in a trench for storage until needed for forest planting

I. Standard sphagnum bale--The packaging of seedlings with sphagnum moss around the roots, reinforced kraft paper wrapping, and the seedling tops exposed

J. Kraft-polyethelene bag--The packaging of seedlings in a specially designed kraft bag with polyethelene liner of the thickness to allow the excape of gases and not water

K. Seedbed--A site in a nursery where seeds are germinated and seedlings are grown in close arrangement

L. Transplant bed--A site in a nursery where seedlings are grown after they have been lifted from a seedbed and replanted

M. Stratification--A period of cold storage necessary for the chemical reactions in seed to allow germination

INFORMATION SHEET

N. Germination--The growth of a new plant emerging from the seed structure

O. Seed coating--The covering of seed with various chemicals

P. Broadcast seeding--A method of direct seeding with a sowing rate on a per acre basis and by aerial or ground application

Q. Spot seeding--A method of direct seeding with a sowing rate of a number of seeds per spot and the spacing of spots based on the same factors needed for spacing of seedlings

II. Sources of seed

A. Seed orchards

B. Superior trees

C. Commercial seed houses or firms

III. Sources of seedling production in Oklahoma

A. State nursery at Broken Bow--Produces Southern Pine

B. State nursery at Washington--Produces hardwood and other pine

Applicaton form for obtaining tree seedling on the following page

DO NOT WRITE IN THIS BOX

ORDER NO. DELIVER DATE:

1-4 19-20 21-22 23-24

APPLICATION FOR FOREST TREE SEEDLINGS

(PLEASE FILL OUT THIS FORM IN ITS ENTIRETY. FAILURE TO DO SO MAY DELAY PROCESSING OF YOUR ORDER.)

Name: Last First Middle | PHONE:

6-34

Order trees in multiples of 50 (100-150-200, etc.)
Minimum order 100 plants.

ADDRESS: Street City State Zip Code | 01

35-59 60-71 72-73 74-78 79-80

LAND DESCRIPTION:

Sec.	Township	Range	County	State
1-6	7-9	10-12	13-14	15-16

OWNERSHIP CLASS:
1. Private
2. Industrial
3. City Gov't
4. State Gov't
5. Fed. Gov't

17
CIRCLE ONLY ONE

PURPOSE
1. Windbreak
2. Shelterbelt
3. Erosion Ctl.
4. Post Lot
5. Wildlife
6. Timber
7. X-mas Trees
8. XXXXXXXXXX

18
CIRCLE ONLY ONE

SHIP TO ______________________________

____

NEAREST MOTOR FREIGHT OFFICE TO YOUR

TOWN: ______________________________

DESIRED DELIVERY DATE

May we substitute a species of equal or greater value if we are out of the stock ordered?

☐ YES ☐ NO

In consideration for the granting of this application, I agree to:

1. Plant the trees for woodlands, windbreaks, or shelterbelts, for forestation, erosion control, wildlife habitat, or other utility purpose, and to protect them from loss.
2. Not to sell any live trees with roots attached or use these for yard beautification, single shade trees, or in borders.
3. Pay to the State of Oklahoma the sum of five dollars ($5.00) for each tree LISTED HEREON IF ANY ARE SOLD OR USED IN VIOLATION of Rule No. 2 above.

SIGNED: ______________________ DATE: ____________

Mail to: DIRECTOR, FORESTRY DIVISION
State Department of Agriculture
122 State Capitol
Oklahoma City, Oklahoma 73105

DO NOT WRITE IN THIS BLOCK

Receipt No. ____________
Date Shipped ____________
Via ____________
Lbs. ____________
No. of Bundles ____________
Cost ____________
Approved by ____________ N 88

C.	P.O.	V.M.
19	20	21

Send **NO MONEY.** You will be billed following confirmation of your order. Trees will not be shipped until receipt of payment following billing.

TREES

	Qty. Desired	Price	
01			Arborvitae
02			Black Locust
03			Catalpa
04			
05			Mulberry
06			Osage Orange
07			Sycamore
08			
09			Redcedar
10			Austrian Pine
11			Ponderosa Pine
12			Scotch Pine
13			Cottonwood
14			
15			
16			

SOUTHERN PINE

20			Loblolly
21			Shortleaf
22			Slash

SHRUBS

24			Autumn Olive
25			Euonymus
26			Multiflora Rose

TREE SEED

29			Black Walnut (stratified nuts)

WILDLIFE PACKAGE

32			Pkg. (No. of Pkg.)

APPL. DATE	TOT. QTY.	TOT. PRICE	02
61-66	67-72	73-78	79-80

INFORMATION SHEET

COPY 1

INFORMATION SHEET

IV. Seedling packaging

- A. Standard sphagnum bale
- B. Kraft-polyethelene bags

V. Care of seedlings in transport

(NOTE: Water and temperature are very critical in transporting seedlings.)

- A. Cover from sun and wind
- B. Water bales every two hours and turn kraft-polyethelene bags over
- C. Store or stack to insure free air circulation (or)
- D. Refrigerate at 35°F

  (NOTE: Never refrigerate below 35° to prevent freezing and to protect during winter months.)

VI. Storage of seedlings (both package types)

- A. Short storage up to four weeks
  - 1. Racks
  - 2. Water bales every day

    (NOTE: Use one quart per bale.)
- B. Long storage over four weeks
  - 1. Refrigerate at 35°F (or)
  - 2. Heeling-in at the planting site

VII. Classifications of planting stock (seedlings) (Transparency 1)

- A. Seedbeds--First number
- B. Transplant beds--Second number

VIII. Factors for spacing seedlings

- A. Site
- B. Growth habit of the species
- C. Class of planting stock

INFORMATION SHEET

D. Expected survival

E. Management objective

F. Future sivicultural treatment

IX. Tools used in hand planting (Transparency 2)

A. Planting bar

B. KBC bar

C. Tree planting hoe

D. Tree planting bag

X. Methods of hand planting seedlings

A. Bar-slit

B. Grub-hoe-slit

C. Side-hole

D. Wedge

XI. Shortleaf pine cone collection--Core matures from October 10 to 30

(NOTE: One bushel of cones will produce approximately one pound of seed or 48,000 seeds.)

XII. Procedure for seed treatment before seeding

A. Stratification

(NOTE: Some species require scarification, roughing the seed coat, prior to stratification.)

B. Germination tests

(NOTE: Germination tests are an important factor in determining sowing rate of seed.)

C. Seed coating

(NOTE: Seed coating with various chemicals in latex serves as a camouflage and poison against birds and rodents.)

INFORMATION SHEET

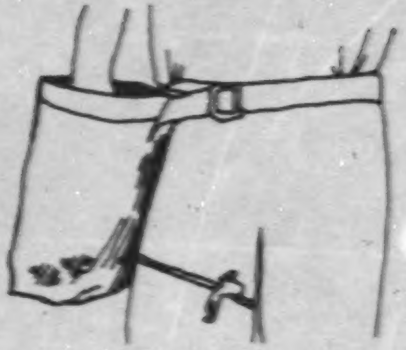
XIII. Seeding methods and applications

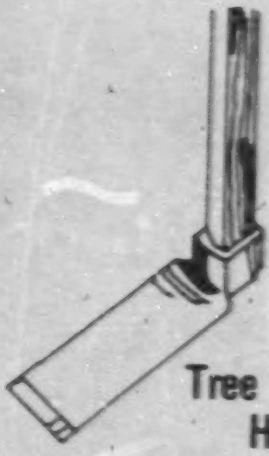
- A. Broadcast seeding
    - 1. Aerial application
    - 2. Ground application
- B. Spot seeding
    - 1. Rake, drop, and step application
    - 2. Panama seeder application.

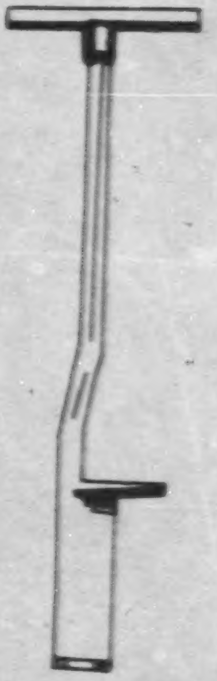
Classification of Planting Stock

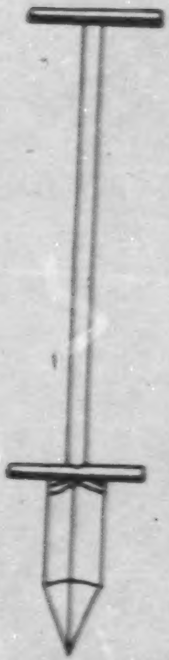
1	—	**2**
FIRST NUMBER (Number of Seasons in Seed Bed - 1 Season)		SECOND NUMBER (Number of Seasons in Transplant Bed - 2 Seasons)
2	—	**2**
(2 Seasons in Seed Bed)		(2 Seasons in Transplant Bed)

Hand Planting Tools


Tree Planting Bag


Tree Planting Hoe


Planting Bar


KBC Bar

SEEDING AND PLANTING
UNIT III

JOB SHEET #1–HAND PLANT SEEDLINGS

I. Tools and materials needed

   A. Planting bar and planting bag

   B. 50' tape

   C. 200 pine seedlings

   D. An area to plant indicated by the instructor

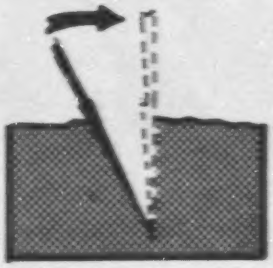
II. Procedure

   A. Plant seedlings on a 6' X 8' spacing with 8 feet between rows and 6 feet between seedlings in the row

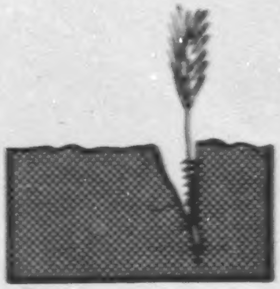
   B. Measure out the required spacing and pace the required distance until satisfied the distance can be obtained by pacing

   C. Plant seedlings using the following procedure for the bar-slit method:

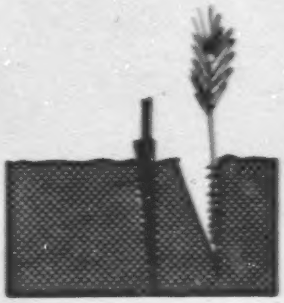
   (NOTE: Make sure seedling roots are kept moist.)



1. Insert bar at angle shown and push forward to upright position

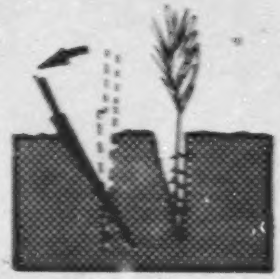


2. Remove bar and place seeding at correct depth

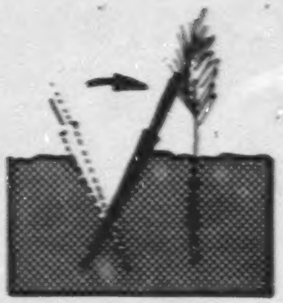


3. Insert bar 2 inches toward yourself from seedling

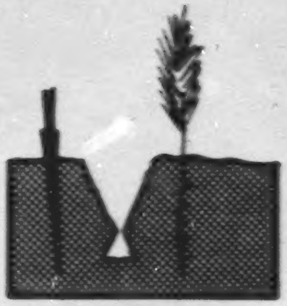
JOB SHEET #1



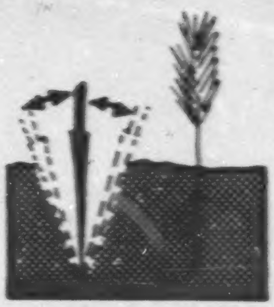
4. Pull handle of bar toward yourself to firm soil at bottom of roots



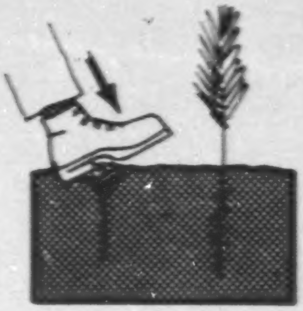
5. Push handle of bar forward to firm soil at top of roots



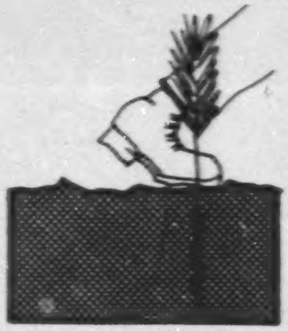
6. Insert bar 2 inches from last hole



7. Push forward then pull backward to fill hole



8. Fill in last hole by stamping with heel



9. Firm soil around seedling with the foot

JOB SHEET #1

D. After planting the seedlings, choose at random and dig up ten seedlings for inspection of correct planting technique

E. Use the following guides to check faults in planting technique

1. Seedling loose, pulls up using three needles to pull
2. Packing hole not filled
3. Seedling U-rooted
4. Lateral roots wrapped around seedling
5. Seedling planted too deep (more than 2" on the root crown)
6. Seedling planted too shallow (root crown exposed)
7. Air space in the planting hole
8. Planting hole open at the top

G. Replant the seedling

H. Place an "X" in the correct space in the chart below for each seedling inspected

I. When chart is completed, hand in to the instructor for evaluation.

Seedlings Inspected	Correctly Planted	1	2	3	4	5	6	7	8
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									
						Coded as Item E above			

SEEDING AND PLANTING
UNIT III

TEST

1. Match the terms on the right to the correct definition.

_____a. A method of artificial regeneration by direct seeding of forest tree seed

_____b. A method of artificial regeneration by planting forest tree seedlings

_____c. A group of trees, natural or artificially created, managed for the purpose of providing seed

_____d. A native tree that has genetic characteristics of fast growth, high quality wood, and resistance to disease and insects

_____e. The growing terminals on twigs cut from the superior trees for grafting on common root stock

_____f. A growing tree developed from the grafting of scions on root stock

_____g. The root system from an average seedling from a nursery

_____h. The temporary planting of seedlings in a trench for storage until needed for forest planting

_____i. The packaging of seedlings with sphagum moss around the roots, reinforced kraft paper wrapping, and the seedling tops exposed

1. Clone
2. Standard sphagnum bale
3. Scion
4. Broadcast seeding
5. Seedbed
6. Spot seeding
7. Seed coating
8. Superior tree
9. Germination
10. Transplant bed
11. Root stock
12. Seeding
13. Stratification
14. Seed orchards
15. Kraft-polyethelene bag
16. Heeling-in
17. Planting

_____j. The packaging of seedlings in a specially designed kraft bag with polyethelene liner of the thickness to allow the escape of gases and not water

_____k. A site in a nursery where seeds are germinated and seedlings are grown in close arrangement

_____l. A site in a nursery where seedlings are grown after they have been lifted from a seedbed and replanted

_____m. A period of cold storage necessary for the chemical reactions in seed to allow germination

_____n. The growth of a new plant emerging from the seed structure

_____o. The covering of seed with various chemicals

_____p. A method of direct seeding with a sowing rate on a per acre basis and by aerial or ground application

_____q. A method of direct seeding with a sowing rate of a number of seeds per spot and the spacing of spots based on the same factors needed for spacing of seedlings

2. Name two sources of seed for seeding and planting.

a.

b.

3. List two sources of seedling production in Oklahoma.

a.

b.

4. List two types of seedling packaging.

a.

b.

5. Select from the list below the correct procedure for the care of seedlings in transport.

_____a. Cover from sun and wind

_____b. Water bales every 30 minutes

_____c. Water bales every two hours and turn K-P bags over

_____d. Pack in tightly

_____e. Store or stack to insure free air circulation

_____f. Refrigerate at 35°F

6. Describe ways to store seedlings for both short and long storage.

Short Storage	Long Storage
a.	c.
b.	d.

7. Describe classifications of planting stock.

a.

b.

8. Select from the list below the factors for spacing seedlings. Circle the correct answers.

a. Expected survivial

b. Time of day

c. Class of planting stock

d. Temperature

e. Type of seedling packaging

f. Site

g. Wind conditions

h. Growth habit of the species

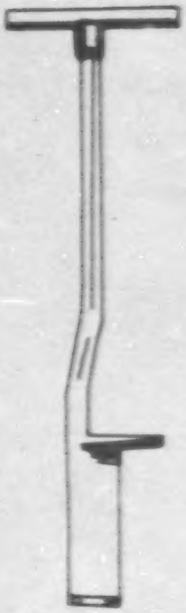
i. Management objective

j. Future sivicultural treatment

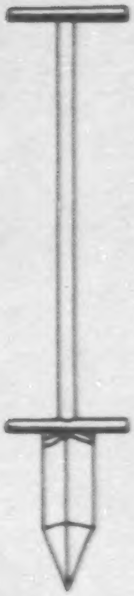
k. Length of storage

9. Identify the tools used in hand planting by placing the proper number in the blanks provided.

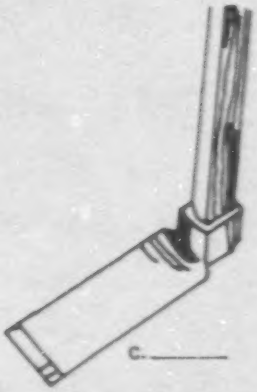
1. Tree planting hoe
2. KBC bar
3. Tree planting bag
4. Planting bar



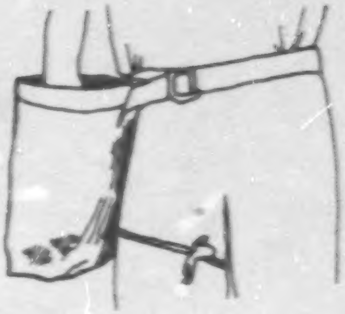
a.______



b.______



c.______



d.______

10. Select from this list the four methods of hand planting seedlings by placing an "X" in the blanks provided.

_____a. Square
_____b. Wedge
_____c. Grub-hoe-slit
_____d. Shovel-hole
_____e. Side-hole
_____f. Bar-slit

11. Describe time to collect shortleaf pine cones.

12. Arrange in order the procedure for seed treatment before seeding.

_____a. Germination tests

_____b. Seed coating

_____c. Stratification

13. Match the types of seeding applications to the methods of seeding.

Broadcast Seeding	Spot Seeding	Applications	
a.	b.	1.	Rake, drop, and step
		2.	Ground
		3.	Aerial
		4.	Panama seeder

14. Demonstrate the ability to hand plant seedlings.

(NOTE: If this has not been accomplished prior to the test, ask the instructor when it should be completed.)

SEEDING AND PLANTING
UNIT III

ANSWERS TO TEST

1. a. 12
   b. 17
   c. 14
   d. 8
   e. 3
   f. 1
   g. 11
   h. 16
   i. 2
   j. 15
   k. 5
   l. 10
   m. 13
   n. 9
   o. 7
   p. 4
   q. 6

2. Any two of the following
   a. Seed orchards
   b. Superior trees
   c. Commercial seed houses or firms

3. a. State Nursery at Broken Bow
   b. State Nursery at Washington

4. a. Standard sphagnum bale
   b. Kraft-polyethelene bags

5. a, c, e, f

6. a. Racks
   b. Water bales every day
   c. Refrigerate 35°F (or)
   d. Heel-in at planting site

7. a. Seedbeds--First number
   b. Transplant beds--Second number

8. a, c, f, h, i, j
9. a. 4
   b. 2
   c. 1
   d. 3
10. b, c, e, f
11. October 10 to 30
12. a. 2
    b. 3
    c. 1
13. a. 2, 3
    b. 1, 4
14. Performance skill will be evaluated to the satisfaction of the instructor.

TIMBER STAND IMPROVEMENT
UNIT IV

TERMINAL OBJECTIVE

After completion of this unit, the student should be able to select from a list the methods for cleaning, liberation, and improvement of timber stands. He should also be able to complete a tree injection. This knowledge will be evidenced through demonstration and by scoring eighty-five percent on the unit test.

SPECIFIC OBJECTIVES

Aftor completion of this unit, the student should be able to:

1. Match terms associated with timber stand improvement to the correct definition.
2. Select from a list of terms the correct classifications of intermediate cuttings.
3. Select from a list of methods those recommended for cleaning.
4. Select from a list of methods those recommended for liberation.
5. Select from a list of methods those recommended for improvement.
6. List four agents of damage requiring salvage cutting.
7. Select from a list the correct factors influencing pruning.
8. Match the chemical compounds to the correct herbicide type.
9. Identify the hand tools used to apply herbicides.
10. Demonstrate the ability to:
    - A. Classify timber stand improvement needs.
    - B. Complete a tree injection.

TIMBER STAND IMPROVEMENT
UNIT IV

SUGGESTED ACTIVITIES

I. Instructor:

   A. Provide students with objective sheet.

   B. Provide students with information and job sheets.

   C. Make transparencies.

   D. Discuss terminal and specific objectives.

   E. Discuss information sheet.

   F. Demonstrate and discuss procedures outlined in the job sheets.

   G. Arrange field trips to allow students an opportunity to identify timber stand improvement classes and to inject trees.

   H. Give test.

II. Students:

   A. Read objectives.

   B. Study information sheet.

   C. Demonstrate the ability to accomplish the procedures outlined in the job sheets.

   D. Participate in field trip.

   E. Take test.

INSTRUCTIONAL MATERIALS

I. Included in this unit:

   A. Objectives

   B. Information sheet

   C. Transparency masters

      1. TM 1–Cleaning

      2. TM 2–Liberation

    3. TM 3–Improvement
    4. TM 4–Herbicide Hand Tools

D. Job sheets

    1. Job Sheet #1–Classify Timber Stand Improvement Needs
    2. Job Sheet #2–Complete a Tree Injection

E. Test

F. Answers to test

II. Reference–Hawley, Ralph C. and David M. Smith. *The Practice of Siviculture.* New York: Wiley & Sons.

TIMBER STAND IMPROVEMENT
UNIT IV

INFORMATION SHEET

I. Terms and definitions

A. Intermediate cuttings--All cuttings made through the rotation period except those cuttings made for the purpose of regeneration

B. Timber stand improvement (TSI)--The intermediate cuttings that involve an investment rather than revenue

C. Cleaning--A cutting in a stand not past the sapling stage in order to free the best trees of the same size

D. Liberation--A cutting in a young stand to release it from overhead competition from older trees

E. Thinning--A cutting in a young stand to stimulate growth in the trees left

F. Improvement--A cutting in an immature stand of merchantable size in order to improve composition

G. Composition--The species of trees in a stand

H. Salvage cutting--A cutting made to remove dead or damaged trees from a stand

I. Pruning--A cutting in which the branches of trees are removed in order to increase the quality of the final product

J. Herbicide-A chemical used to kill plants

K. Basal herbicide application--A method of applying herbicide to the base of young trees, one to two feet in height, usually by spraying

L. Stump herbicide application--A method of applying herbicide to a fresh cut stump of a tree

(NOTE: Stump herbicide is usually applied by painting, pouring, or spraying.)

M. Foliage herbicide application--A method of applying herbicide to the leaves of plants either by aerial or ground spraying

N. Girdling--The cutting around the stem of a tree completely into the wood and the removal of the cambium layer in the form of chips or sawdust

O. Injection--A method of applying herbicide into the system of a tree

(NOTE: There are various tools designed for this purpose.)

INFORMATION SHEET

P. Phytotoxin--A plant poison

Q. Auxin--A hormone produced by plants that regulates the growth of the plant

R. 2-4-D herbicide--A synthetic auxin, dichlorophenoxyacetic acid sold as amine or ester in pounds of acid equivalent per gallon

S. 2-4-5-T herbicide--A synthetic auxin, trichlorophenoxyacetic acid sold as amine or ester in pounds of acid equivalent per gallon

T. Tree injectors--Tools used to inject herbicide into trees

U. Backpack mist blower--A gasoline motor operated fan blower that combines herbicide into an air stream as a mist and is used in foliage herbicide application

V. Amine--A chemical compound formed using ammonia

W. Ester--A chemical compound formed from an acid and alcohol

II. Classifications of intermediate cuttings

A. Cleaning

B. Liberation

C. Thinning

D. Improvement

E. Salvage cutting

F. Pruning

III. Methods of cleaning (Transparency 1)

A. Cutting

B. Herbicide application

1. Basal

2. Stump

3. Foliage

INFORMATION SHEET

IV. Methods of liberation (Transparency 2)

- A. Cutting
- B. Girdling
- C. Injection
- D. Foliage herbicide application

  (NOTE: Applicable only in some cases such as to liberate pine from hardwood.)

V. Methods of improvement (Transparency 3)

- A. Mark and sell
- B. Cutting
- C. Girdling
- D. Injection
- E. Foliage herbicide application

VI. Agents of damage requiring salvage cutting

- A. Disease
- B. Insects
- C. Fire
- D. Wind
- E. Snow and ice
- F. Environmental pollution

VII. Factors influencing pruning

- A. End value

  (NOTE: Will end value justify pruning cost?)

- B. Rotation period

  (NOTE: Is the rotation period to justify cost or to produce quality wood?)

- C. Number of crop trees per acre at the end of rotation to justify pruning cost
- D. Cost of pruning

INFORMATION SHEET

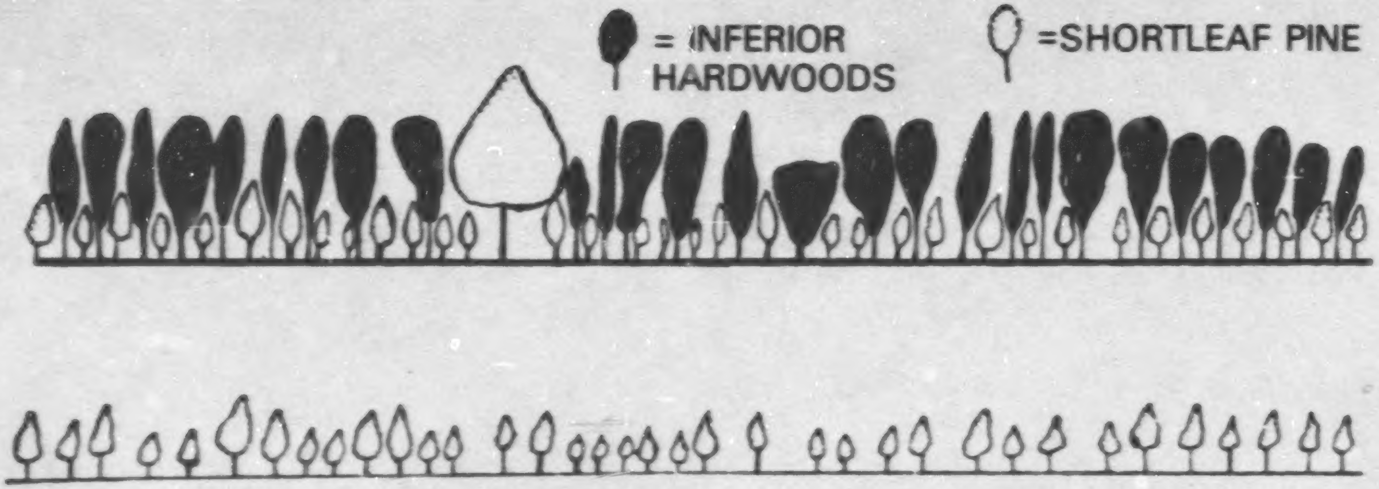
VIII. Herbicides (silvicides) and chemical compounds

- A. Phytotoxins
  - 1. Ammate (ammonium sulfamate)
  - 2. Arsenic compounds
- B. Synthetic auxins
  - 1. 2-4-D
  - 2. 2-4-5-T

IX. Hand tools used to apply herbicides (Transparency 4)

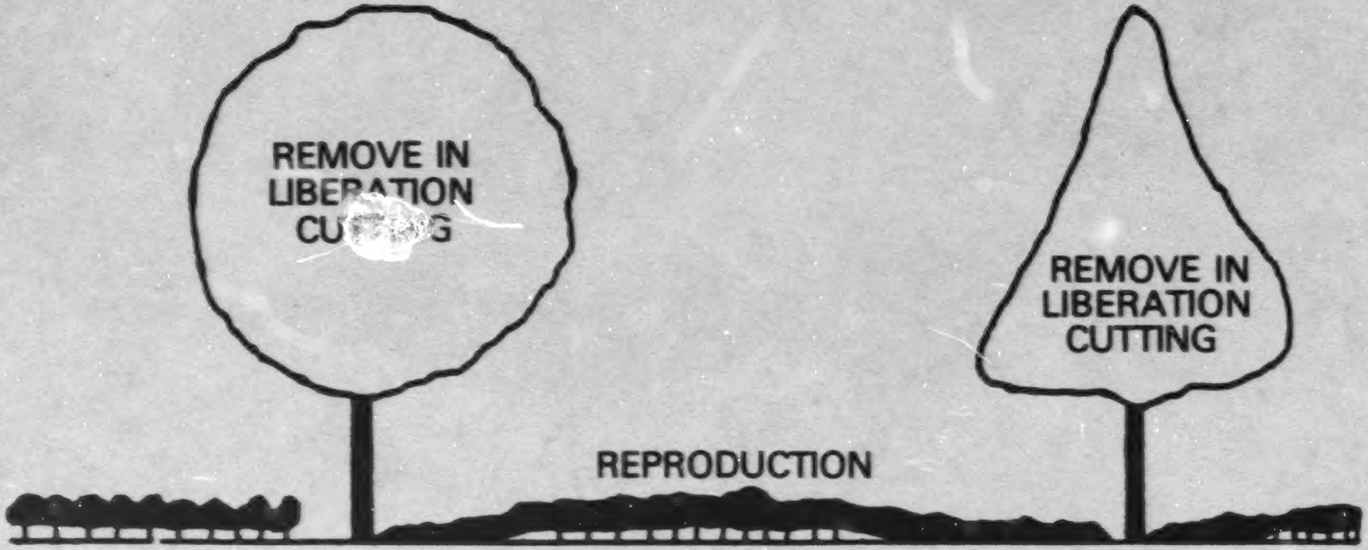
- A. Tree injector
- B. Backpack mist blowers

Cleaning



A Stand of Shortleaf Pine Before (above) and After (below) the Removal of Overtopping, Inferior Hardwoods in a Cleaning This Represents an Extreme Type of Cleaning in which all Trees Overtopping the Desirable Ones Must be Removed Because the Hardwoods Grow so much Faster than Pine The Large Pine has been Cut Because it might otherwise Develop into a Limby Wolf Tree

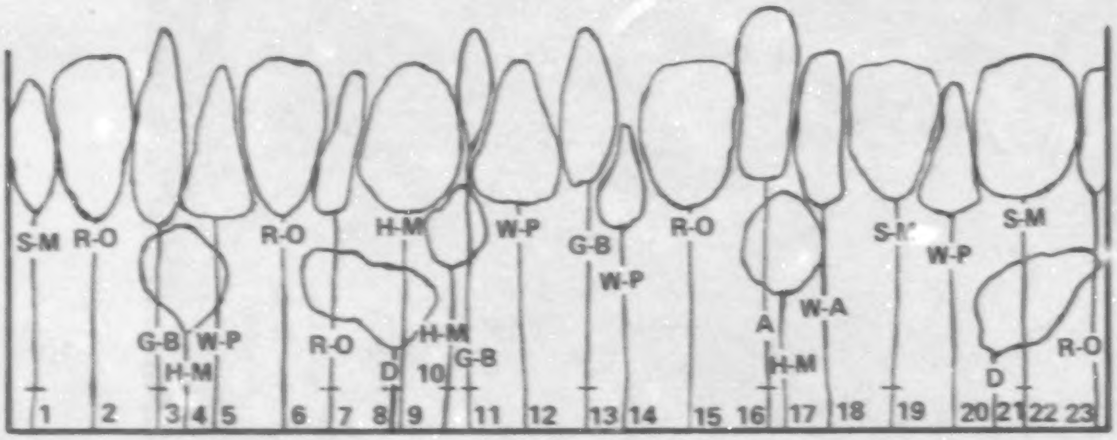
Liberation


REMOVE IN LIBERATION CUTTING
REMOVE IN LIBERATION CUTTING
REPRODUCTION

A Young Stand of Reproduction at the Stage Where a Liberation Cutting could be Carried Out to Best Advantage The Overtopping Wolf Trees have not yet caused any Deformities or Serious Reductions of Growth in the New Crop

Improvement

INFERIOR SPECIES	VALUABLE SPECIES
A=Aspen D=Dogwood	R-O=Red Oak H-M=Hard Maple
G-B=Gray Birch S-M=Soft Maple	W-A=White Ash W-P=White Pine


S-M
R-O
G-B
W-P
H-M
R-O
R-O
H-M
D
H-M
10
G-B
W-P
G-B
W-P
R-O
A
W-A
H-M
S-M
W-P
S-M
D
R-O
1
2
3
4
5
6
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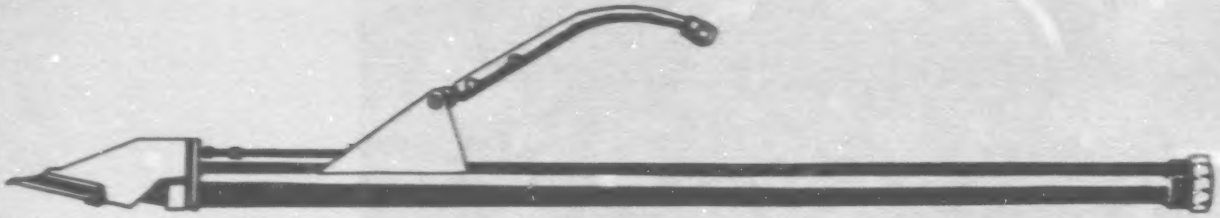
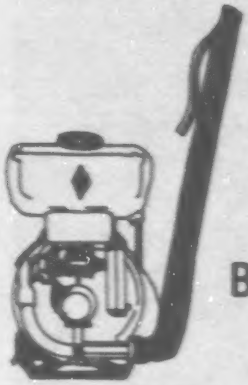
22
23

A 50-year-old Mixed Stand Marked for an Improvement Cutting The Trees to be Cut are Indicated by Dashes The Removal of Trees 3, 11, 13, 16, 19, and 22 Constitutes the True Improvement Cutting and Resembles a Cleaning, Because Dominant Trees of Inferior Species are Cut to favor more Valuable Individuals The Cutting of Trees 1, 7, 8, and 10 Corresponds to a C-grade Low Thinning Trees 4, 14, 17, and 21 are, however, left standing to fill openings created by the Removal of Dominant Trees of Poor Species

Herbicide Hand Tools



Tree Injector



Back Pack Mist Blower

TIMBER STAND IMPROVEMENT
UNIT IV

JOB SHEET #1--CLASSIFY TIMBER STAND IMPROVEMENT NEEDS

I. Materials needed

   A. Clipboard and pencil

      (NOTE: A knowledge of tree species identification, local timber market, and species merchantability is very important.)

   B. Areas to classify indicated by the instructor

II. Procedure

   A. Place an "X" in the correct space in the chart below

   B. When completed, turn in to the instructor for evaluation

Timber Stand	Cleaning	Liberation	Improvement	Salvage Cutting	Pruning
Area 1					
Area 2					
Area 3					
Area 4					
Area 5					

TIMBER STAND IMPROVEMENT
UNIT IV

JOB SHEET #2–COMPLETE A TREE INJECTION

I. Tools and materials needed

A. Tree injector

B. 5/16" open end wrench

C. Milliliter volume measure

D. Hand ax

E. Trees indicated by the instructor

F. 2-4-D herbicide (4 lb. acid equivalent) or recommended herbicide

II. Procedure

A. Place the discharge tube into the milliliter measure

(NOTE: See attached parts diagram.)

B. Pump the operating handle ten times

C. The milliliter measure should read ten milliliters; if not, then adjust as follows:

1. For less than ten, move the locknut clockwise (down toward the point of the injector) until a correct measurement of milliliters is obtained

2. For more than ten, move the locknut counterclockwise until a correct measurement is obtained

D. Inject trees at the base of the stem within a range of twelve inches to the groundline

E. Space injections three inches apart

F. Make sure the bit cuts through the bark and into the wood of the tree before releasing the herbicide

G. Use the hand ax to chop limbs out of the way when the limbs hinder injection

JOB SHEET #2

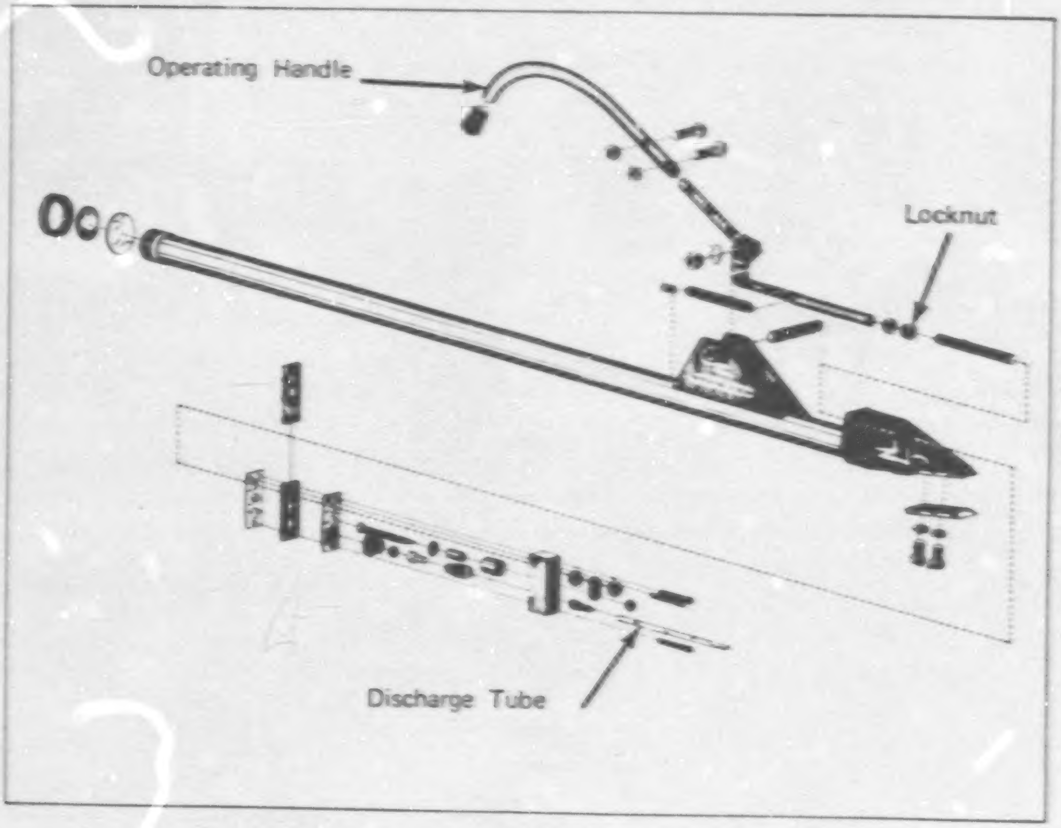
H. When all trees designated have been injected, wait two hours

I. After two hours, select ten trees at random and chop out one injection per tree

J. Above the injection there should be black to dark brown streaks in the sapwood if the tree was injected correctly

K. Ask the instructor to evaluate your sample tree

L. Inspect the area two weeks later for signs of herbicide effect



TIMBER STAND IMPROVEMENT
UNIT IV

TEST

1. Match the terms on the right to the correct definition.

_____a. All cuttings made through the rotation period except those cuttings made for the purpose of regeneration

_____b. The intermediate cuttings that involve an investment rather than revenue

_____c. A cutting in a stand not past the sapling stage in order to free the best trees of the same size

_____d. A cutting in a young stand to release it from overhead competition from older trees

_____e. A cutting in a young stand to stimulate growth in the trees left

_____f. A cutting in an immature stand of merchantable size in order to improve composition

_____g. The species of trees in a stand

_____h. A cutting made to remove dead or damaged trees from a stand

_____i. A cutting in which the branches of trees are removed in order to increase the quality of the final product

_____j. A chemical used to kill plants

_____k. A method of applying herbicide to the base of young trees, one or two feet in height, usually by spraying

1. Liberation
2. Stump herbicide application
3. Pruning
4. Auxin
5. Composition
6. Backpack mist blower
7. Ester
8. Tree injectors
9. Amine
10. Herbicide
11. 2-4-D herbicide
12. Intermediate cuttings
13. 2-4-5-T herbicide
14. Salvage cutting
15. Phytotoxin
16. Thinning
17. Timber stand improvement (TSI)
18. Foliage herbicide application

_____l. A method of applying herbicide to the leaves of plants either by aerial or ground spraying

_____m. A method of applying herbicide to a fresh cut stump of a tree

_____n. The cutting around the stem of a tree completely into the wood and the removal of the cambium layer in the form of chips or sawdust

_____o. A method of applying herbicide into the system of a tree

_____p. A plant poison

_____q. A hormone produced by plants that regulates the growth of the plant

_____r. A synthetic auxin, dichlorophenoxyacetic acid sold as amine or ester in pounds of acid equivalent per gallon

_____s. A synthetic auxin, trichlorophenoxyacetic acid sold as amine or ester in pounds of acid equivalent per gallon

_____t. Tools used to inject herbicide into trees

_____u. A gasoline motor operated fan blower that combines herbicide into an air stream as a mist and is used in foliage herbicide application

_____v. A chemical compound formed using ammonia

_____w. A chemical compound formed from an acid and alcohol

19. Injection

20. Cleaning

21. Girdling

22. Basal herbicide application

23. Improvement

2. Select from the list of terms below the correct classifications of intermediate cuttings. Circle the correct answers.

a.	Pruning	f.	Liberation
b.	Felling	g.	Tree girdling
c.	Thinning	h.	Salvage cutting
d.	Improvement	i.	Cleaning
e.	Competitors	j.	Injection

3. Select from the list below the TSI methods recommended for cleaning by circling the correct answers.

   a. Foliage herbicide application

   b. Injection

   c. Girdling

   d. Cutting

   e. Stump herbicide application

   f. Basal herbicide application

   g. Mark and sell

4. Select from the list below the TSI methods recommended for liberation by circling the correct answers.

   a. Foliage herbicide application

   b. Injection

   c. Girdling

   d. Cutting

   e. Stump herbicide application

   f. Basal herbicide application

   g. Mark and sell

5. Select from the list below the TSI methods recommended for improvement by circling the correct answers.

   a. Foliage herbicide application
   b. Injection

c. Girdling

d. Cutting

e. Stump herbicide application

f. Basal herbicide application

g. Mark and sell

6. List four agents of damage requiring salvage cutting.

a.

b.

c.

d.

7. Select from the list below the correct factors influencing pruning by placing an "X" in the blanks provided.

_____a. Number of crop trees per acre at the end of rotation

_____b. Cost of pruning

_____c. Type of tools available

_____d. Rotation period

_____e. The presence or absence of disease

_____f. End value

_____g. The presence or absence of insects

8. Match the chemical compounds to the correct herbicide type.

a. Phytotoxins   b. Synthetic Auxins

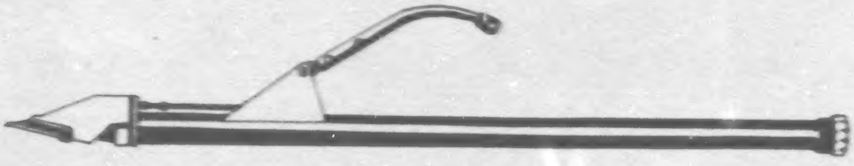
1. Ammate (ammonium sulfamate)

2. 2-4-D

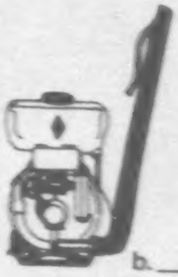
3. Arsenic compounds

4. 2-4-5-T

9. Identify the hand tools used to apply herbicides.



a. ____________________



b. ____________________

10. Demonstrate the ability to:

a. Classify timber stand improvement needs.

b. Complete a tree injection.

(NOTE: If these have not been accomplished prior to the test, ask the instructor when the above activities should be completed.)

TIMBER STAND IMPROVEMENT
UNIT IV

ANSWERS TO TEST

1. a. 12
   b. 17
   c. 20
   d. 1
   e. 16
   f. 23
   g. 5
   h. 14
   i. 3
   j. 10
   k. 22
   l. 18
   m. 2
   n. 21
   o. 19
   p. 15
   q. 4
   r. 11
   s. 13
   t. 8
   u. 6
   v. 9
   w. 7

2. a, c, d, f, h, i

3. a, d, e, f

4. a, b, c, d

5. a, b, c, d, g

6. Any four of the following
   a. Disease
   b. Insects
   c. Fire
   d. Wind
   e. Snow and ice
   f. Environmental pollution

7. a, b, d, f

8. a. 1, 3
   b. 2, 4

9. a. Tree injector
   b. Backpack mist blower

10. Performance skills will be evaluated to the satisfaction of the instructor.

FIRE FIGHTING
UNIT I

TERMINAL OBJECTIVE

After completion of this unit, the student should be able to name the parts of the fire triangle, the classes of fire, the methods of fire attack, and the methods of crew organization. The student should also be able to arrange in order of occurrence the standard fire causes in Oklahoma and use the hand tools to function as a member of a fire crew. This knowledge will be evidenced through demonstration and by scoring eighty-five percent on the unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms associated with fire fighting to the correct definition.
2. Name the three elements of the fire triangle.
3. Arrange in numerical order of occurrence the standard fire causes in Oklahoma.
4. Name the three purposes of fire control organizations.
5. Select from a list the two means of fire prevention.
6. Match the individual items of work responsibility to the fire presuppression duty.
7. Name the three classes of fire.
8. Name the four methods of fire attack.
9. Name the four methods of crew organization using hand tools.
10. Match the hand tools to the correct tool class.
11. Demonstrate the ability to use hand tools and function as a member of a fire crew.

FIRE FIGHTING
UNIT I

SUGGESTED ACTIVITIES

I. Instructor:

   A. Provide students with objective sheet.

   B. Provide students with information and job sheets.

   C. Make transparencies.

   D. Discuss terminal and specific objectives.

   E. Discuss information sheet.

   F. Demonstrate the procedure outlined in the job sheet.

   G. Arrange field trips to allow students an opportunity to practice use of hand tools and fire crew organization.

   H. Give test.

II. Students:

   A. Read objectives.

   B. Study information sheet.

   C. Demonstrate the ability to accomplish the procedure outlined in the job sheet.

   D. Participate in field trip.

   E. Take test.

INSTRUCTIONAL MATERIALS

I. Included in this unit:

   A. Objectives

   B. Information sheet

   C. Transparency masters

      1. TM 1–The Fire Triangle

      2. TM 2–Fire Hand Tools

      3. TM 3–Backfiring Tools

D. Job Sheet #1–Operate Hand Tools for a Fire Crew

E. Test

F. Answers to test

II. Reference–Hawley, Ralph C. and Paul W. Stickel. *Forest Protection.* New York: Wiley and Sons.

FIRE FIGHTING
UNIT I

INFORMATION SHEET

I. Terms and definitions

   A. Wildfire--The uncontrolled burning of fire

   B. Incendiary--The unlawful and intentional setting of fire

   C. Debris burning--Wildfire caused by the burning of trash

   D. Smoker--Any fire starting from the use of tobacco

   E. Campfire--Any fire resulting from cooking or warming or from campfires

   F. Lumbering--Any fire resulting from a logging or sawmilling operation

   G. Railroads--Any fire resulting from the operation of railroads

   H. Lightning--Any fire resulting from lightning strikes

   I. Miscellaneous--Any fire than cannot be placed in one of the other standard causes of fire

   J. Prevention--Any action associated with stopping a wildfire before it gets started

   K. Presuppression--Any action associated with being ready in case a wildfire occurs

   L. Suppression--Any action associated with stopping a wildfire

   M. Detection--The planned observance from the occurrence of wildfire

   N. Fire danger rating--The measurement and resultant rating of the variables that determine whether fires will start, spread, and do damage

   O. Fire break--A strip of land cleared of fuels that could burn

   P. Prescribed burning--The controlled use of fire

   Q. Ground fire class--A fire that burns underground such as duff and peat fires

   R. Surface fire class--A fire that burns only the surface fuels

INFORMATION SHEET

S. Crown fire class--A fire that burns through the tops of trees

T. Direct attack--A method using various means such as water, soil, and beating to attack the fire directly at the flames

U. Two-foot attack--A method of attack where the fuel is removed from an eighteen inch strip two feet from the fire edge, and the strip is known as the fire line

V. Parallel--A method of attack where the fire is too hot to fight directly, or two feet from the edge, and a strip eighteen inches wide (fire line) is made by removing the fuel at a distance of more than three feet from the fire

W. Backfiring--A method of attack where the fire is extremely hot and advancing rapidly in which a fire line is constructed, then a fire is set to meet the advancing fire

X. Sector fire crew--A method of crew organization where each individual is assigned a segment of fire line to construct and after he completes the sector, he moves to the front of the progressing crew

Y. One-lick--A method of crew organization where each man in the crew walks at a slow pace along a line to construct and make one lick with the hand tool as he walks

(NOTE: The pace is regulated according to the size of crew. When the last man has passed along the line, the intention is that the fire line should be finished.)

Z. Progressive--A method of crew organization where each man is assigned a short sector (usually about ten feet) of fire line to construct and as each member finishes his sector of fire line, he says "bump" and moves up to finish the sector of the man in front of him

AA. Rotary--A method of fire crew organization where the direct attack method with shovels and soil is used in which the first man throws a shovel of soil on the fire and steps aside to obtain another shovel of soil and moves to the end of the line

(NOTE: This usually works best with five men or less and has the appearance of a revolving wheel moving along the fire line.)

II. Elements of the fire triangle (Transparency 1)

A. Air (O_2)

B. Fuel

C. Heat

(NOTE: You must have all three elements to have a fire.)

INFORMATION SHEET

III. Standard fire causes in order of occurrence in Oklahoma

  A. Incendiary

  B Debris burning

  C. Smoker

  D. Campfires

  E. Lumbering

  F. Railroads

  G. Lightning

  H. Miscellaneous

IV. Purposes of fire control organizations

  A. Prevention

  B. Presuppression

  C. Suppression

V. Means of fire prevention

  A. Public education

  B. Law enforcement

VI. Fire presuppression duties

  A. Detection system maintenance

    1. Fire towers

    2. Aerial patrol

    3. Ground patrol

  B. Communication system maintenance

    1. Radios

    2. Telephone

INFORMATION SHEET

C. Transportation system maintenance

    1. Crew and equipment carriers

    2. Roads and trails

D. Equipment

    1. Equipment maintenance

    2. Equipment distribution

E. Personnel

    1. Training

    2. Distribution of crews

F. Fire danger rating

    1. Maintenance of weather stations

    2. Fire danger measurements

G. Firebreaks and fuel reduction

    1. Development and maintenance of firebreaks

    2. Prescribed burning

VII. Fire classes

A. Ground

B. Surface

C. Crown

VIII. Methods of fire attack

A. Direct

B. Two-foot

C. Parallel

D. Backfiring

INFORMATION SHEET

IX. Methods of fire crew organization using hand tools

  A. Sector

  B. One-lick

  C. Progressive

  D. Rotary

X. Classes of hand tools (Transparency 2)

  A. Cutting and felling

    1. Axes and brushhooks

    2. Saws

  B. Raking

    1. Council rake

    2. Mcleod rake

  C. Beating

    1. Fire swatter

    2. Any wet material

  D. Digging

    1. Shovel

    2. Pulaski

  E. Water

    1. Backpack pump

    2. Portable power pump and hose

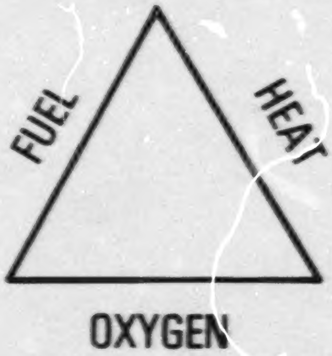
  F. Backfiring (Transparency 3)

    1. Torches

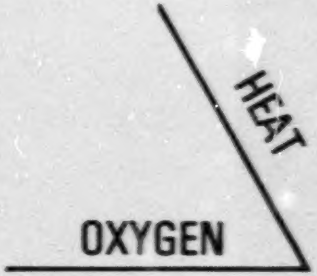
    2. Fuses

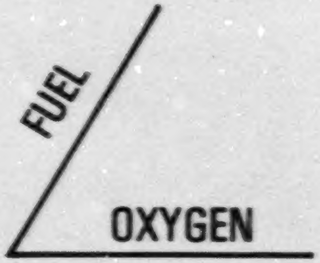
The Fire Triangle

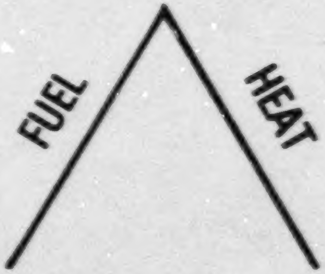
To produce fire, three things must be present at the same time.


FUEL
HEAT
OXYGEN

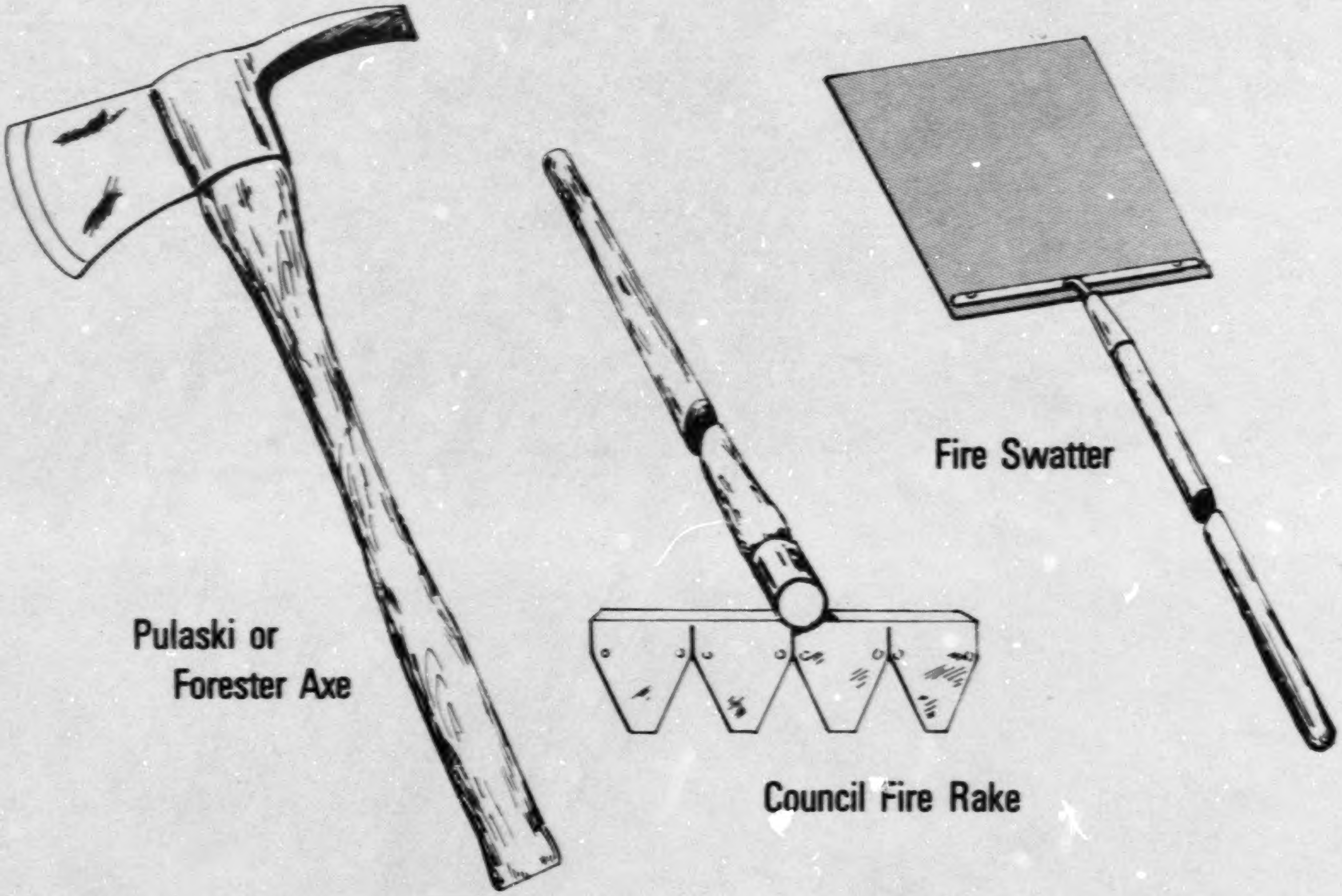
If any one of the three is missing, a fire cannot be started, or with the removal of any one, the fire will be extinguished.


HEAT
OXYGEN


FUEL
OXYGEN



Fire Hand Tools

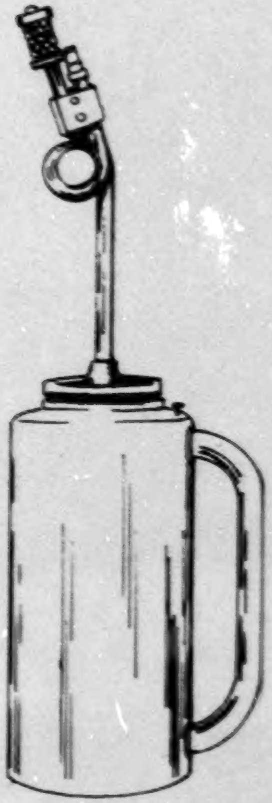


Pulaski or Forester Axe

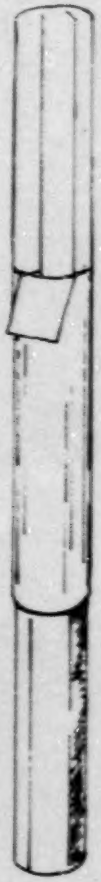
Council Fire Rake

Fire Swatter

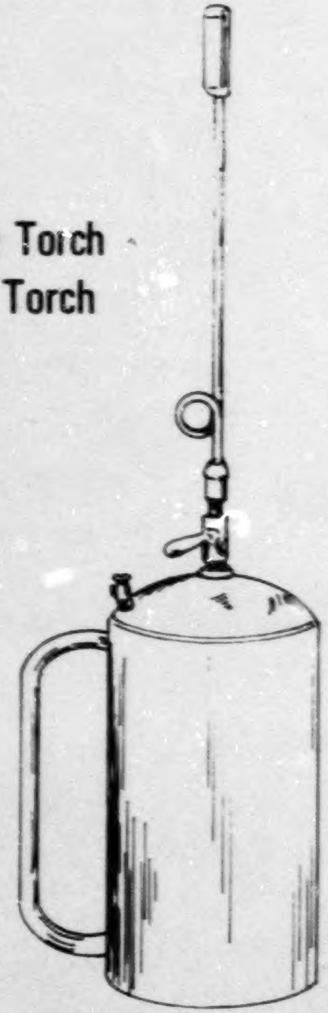
Backfiring Tools



Forester "Sealtite"
Drip Torch



Forest Firing Torch
or "Fusee" Torch



Panama Stainless Steel
Drip Torch

FIRE FIGHTING
UNIT I

JOB SHEET #1–OPERATE HAND TOOLS FOR A FIRE CREW

I. Tools needed

   A. Council rake

   B. Shovel

II. Procedure

   A. Instructor will indicate where the mock fire is burning by using flagging ribbon

   B. Obtain a council tool

   C. Instructions for sector crew

      1. Obtain position and fire line sector from the instructor

      2. Construct an 18" width fire line down to mineral soil along the fire line

      3. Pull the council parallel and then outward away from the fire edge with each stroke

      4. Ask the instructor for evaluation when completed

   D. Instructions for one-lick crew

      1. Use the council rake

      2. Obtain position from the instructor

      3. Advance following the man in front when given the signal to advance

      4. Hit a stroke with the council with each step

      5. Attempt to build an 18" fire line while walking

      6. The instructor will regulate the pace and evaluate the fire line and use of tools

JOB SHEET #1

E. Instructions for progressive crew

1. Use the council rake
2. Obtain position from the instructor
3. Complete the fire line as described in item C on the preceding page
4. When the sector is complete, say "bump" to the man in front and complete the sector he was working on
5. Move up a sector whenever the man behinds says, "bump"

F. Instructions for rotary crew

1. Use the shovel
2. Obtain position from the instructor
3. Obtain a shovel full of dirt
4. After the man in front has thrown his dirt on the fire, advance and throw dirt on the fire
5. If advancing along the fire clockwise, step to the left after throwing dirt
6. Obtain another shovel full of dirt and repeat the procedure
7. The instructor will regulate the pace and evaluate crew action

FIRE FIGHTING
UNIT I

TEST

1. Match the terms on the right to the correct definition.

_____a. The uncontrolled burning of fire

_____b. The unlawful and intentional setting of fire

_____c. Wildfire caused by the burning of trash

_____d. Any fire starting from the use of tobacco

_____e. Any fire resulting from cooking or warming or from campfires

_____f. Any fire resulting from a logging or sawmilling operation

_____g. Any fire resulting from the operation of railroads

_____h. Any fire resulting from lightning strikes

_____i. Any fire that cannot be placed in one of the other standard causes of fire

_____j. Any action associated with stopping a wildfire before it gets started

_____k. Any action associated with being ready in case a wildfire occurs

_____l. Any action associated with stopping a wildfire

_____m. The planned observance from the occurrence of wildfire

1. Campfire
2. Miscellaneous
3. Suppression
4. Prevention
5. Railroads
6. Wildfire
7. Presuppression
8. Smoker
9. Detection
10. Lightning
11. Incendiary
12. Lumbering
13. Debris burning
14. Ground fire class
15. Two-foot attack
16. Crown fire class
17. Sector fire crew
18. Fire break
19. Rotary
20. Backfiring
21. Progressive

_____n. The measurement and resultant rating of the variables that determine whether fires will start, spread, and do damage

_____o. The controlled use of fire

_____p. A strip of land cleared of fuels that could burn

_____q. A fire that burns underground such as duff and peat fires

_____r. A fire that burns only the surface fuels

_____s. A fire that burns through the tops of trees

_____t. A method using various means such as water, soil, and beating to attack the fire directly at the flames

_____u. A method of attack where the fuel is removed from an eighteen inch strip two feet from the fire edge, and the strip is known as the fire line

_____v. A method of attack where the fire is too hot to fight directly, or two feet from the edge, and a strip eighteen inches wide (fire line) is made by removing the fuel at a distance of more than three feet from the fire

_____w. A method of attack where the fire is extremely hot and advancing rapidly in which a fire line is constructed, then a fire is set to meet the advancing fire

_____x. A method of crew organization where each individual is assigned a segment of fire line to construct and after he completes the sector, he moves to the front of the progressing crew

22. Surface fire class
23. One-lick
24. Parallel
25. Prescribed burning
26. Fire danger rating
27. Direct attack

_____y. A method of crew organization where each man in the crew walks at a slow pace along a line to construct and make one lick with the hand tool as he walks

_____z. A method of crew organization where each man is assigned a short sector (usually about ten feet) of fire line to construct and as each member finishes his sector of fire line, he says "bump" and moves up to finish the sector of the man in front of him

____aa. A method of fire crew organization where the direct attack method with shovels and soil is used in which the first man throws a shovel of soil on the fire and steps aside to obtain another shovel of soil and moves to the end of the line

2. Name the three elements of the fire triangle.

a.

b.

c.

3. Arrange in numerical order of occurrence the standard fire causes in Oklahoma.

_____a. Lumbering

_____b. Railroads

_____c. Miscellaneous

_____d. Lightning

_____e. Debris burning

_____f. Incendiary

_____g. Smoker

_____h. Campfires

4. Name the three purposes of fire control organizations.

a.

b.

c.

5. Select from the list below the two means of fire prevention.

______a. Fire fighting

______b. Law enforcement

______c. Maintaining equipment

______d. Public education

6. Match the individual items of work responsibility to the fire presuppression duty. (There is more than one answer for each duty.)

Fire Presuppression Duties

______a. Detection system maintenance

______b. Communication system maintenance

______c. Transportation system maintenance

______d. Equipment

______e. Personnel

______f. Fire danger rating

______g. Firebreaks and fuel reduction

Items of Work Responsibility

1. Telephone
2. Crew and equipment carriers
3. Ground patrol
4. Aerial patrol
5. Maintenance of weather stations
6. Radios
7. Fire towers
8. Training
9. Equipment maintenance
10. Prescribed burning
11. Roads and trails
12. Equipment distribution
13. Development and maintenance of firebreaks
14. Distribution of crews
15. Fire danger measurements

7. Name the three classes of fire.

a.

b.

c.

8. Name the four methods of fire attack.

   a.

   b.

   c.

   d.

9. Name the four methods of crew organization using hand tools.

   a.

   b.

   c.

   d.

10. Match the hand tools to the correct tool class. (There is more than one answer for each tool class.)

_____a. Cutting and felling
_____b. Raking
_____c. Beating
_____d. Digging
_____e. Water
_____f. Backfiring

1. Torches
2. Shovel
3. Axes and brushhooks
4. Portable power pump and hose
5. Mcleod
6. Fire swatter
7. Fuses
8. Pulaski
9. Any wet material
10. Backpack pump
11. Council
12. Saws

11. Demonstrate the ability to use hand tools and function as a member of a fire crew.

(NOTE: If this has not been accomplished prior to the test, ask the instructor when the above activity should be completed.)

FIRE FIGHTING
UNIT I

ANSWERS TO TEST

1. a. 6
   b. 11
   c. 13
   d. 8
   e. 1
   f. 12
   g. 5
   h. 10
   i. 2
   j. 4
   k. 7
   l. 3
   m. 9
   n. 26
   o. 25
   p. 18
   q. 14
   r. 22
   s. 16
   t. 27
   u. 15
   v. 24
   w. 20
   x. 17
   y. 23
   z. 21
   aa. 19

2. a. Air (O_2)
   b. Fuel
   c. Heat

3. a. 5
   b. 6
   c. 8
   d. 7
   e. 2
   f. 1
   g. 3
   h. 4

4. a. Prevention
   b. Presuppression
   c. Suppression

5. b, d

6. a. 3, 4, 7
   b. 1, 6
   c. 2, 11
   d. 9, 12
   e. 8, 14
   f. 5, 15
   g. 10, 13

7. a. Ground
   b. Surface
   c. Crown

8. a. Direct
   b. Two-foot
   c. Parallel
   d. Backfiring

9. a. Sector
   b. One-lick
   c. Progressive
   d. Rotary

10. a. 3, 12
    b. 5, 11
    c. 6, 9
    d. 2, 8
    e. 4, 10
    f. 1, 7

11. Performance skill will be evaluated to the satisfaction of the instructor.

PRESCRIBED BURNING
UNIT II

TERMINAL OBJECTIVE

After completion of this unit, the student should be able to recognize prescribed burning techniques used for various areas, interpret wind, relative humidity, and temperature for a successful burn, and arrange in order the steps of a burning plan. This knowledge will be evidenced through demonstration and by scoring eighty-five percent on the unit test.

SPECIFIC OBJECTIVES

1. Match terms associated with prescribed burning to the correct definition.
2. Select from a list the six correct reasons for prescribed burning.
3. Select from a list the most desirable wind direction and velocity.
4. List the range of preferred relative humidity and the effects of temperature change on relative humidity.
5. Name the desired range of temperature for prescribed burning.
6. Identify correctly illustrations of an anemometer and a psychrometer.
7. Arrange in numerical order the steps of a burning plan.
8. Select from a list the factors which determine the use of the backfire, strip head fire, spot fire, and flank fire techniques in prescribed burning.
9. Demonstrate the ability to:
    a. Determine wind direction and velocity, relative humidity, and temperature.
    b. Determine the prescribed burning technique to use.

PRESCRIBED BURNING
UNIT II

SUGGESTED ACTIVITIES

I. Instructor:

  A. Provide students with objective sheet.

  B. Provide students with information and job sheets.

  C. Make transparencies.

  D. Discuss terminal and specific objectives.

  E. Discuss information sheet.

  F. Demonstrate and discuss procedures outlined in the job sheets.

  G. Arrange field trips to allow students an opportunity to determine wind velocity and direction, relative himidity, temperature, and prescribed burning techniques.

  H. Give test.

II. Students:

  A. Read objectives.

  B. Study information sheet.

  C. Demonstrate the ability to accomplish the procedures outlined in the job sheets.

  D. Participate in field trip.

  E. Take test.

INSTRUCTIONAL MATERIALS

I. Included in this unit:

  A. Objectives

  B. Information sheet

  C. Transparency masters

    1. TM 1--Relative Humidity Affects Fuels

    2. TM 2--Backfire Technique

  3. TM 3–Strip Head Fire Technique
  4. TM 4–Spot Fire Technique
  5. TM 5–Flank Fire Technique

D. Job Sheets

  1. Job Sheet #1–Determine Wind Direction and Velocity, Relative Humidity, and Temperature
  2. Job Sheet #2–Determine Prescribed Burning Techniques

E. Test

F. Answers to test

II. References–USDA, Forest Service. *A Guide to Fire by Prescription.* Washington, D.C.: Superintendent of Documents.

PRESCRIBED BURNING
UNIT II

INFORMATION SHEET

I. Terms and definitions

A. Prescribed burning-Controlled use of fire

B. Wind velocity-Speed of wind, usually measured in miles per hour

C. Relative humidity-Actual amount of moisture in air as compared to the amount that air could hold

(NOTE: High relative humidity means that there is more moisture available for fuels to absorb and thus fuels are hard to ignite and burn.)

D. Anemometer-Instrument that gives wind speed

E. Psychrometer-Instrument that gives temperature and relative humidity

F. Mop-up-Act of making a fire safe, after it has been controlled or burned, by putting out all embers and sparks at a prescribed distance from the fire line

G. Heavy fuel--Contains a high percent of thick material, such as logs, tree tops, and large limbs

H. Medium fuel--Contains light material, such as limbs and tree tops less than 4 inches in diameter

I. Light fuel--Contains grass and leaves with some small limbs and twigs

J. Backfire--Burning against the wind

K. Strip head fire-Burning with the wind using short headfires for a safe fire line

L. Spot fire (also called checkerboard or area ignition)-Setting of a series of small fires that burn together before the momentum of an uncontrolled fire is reached

M. Flank fire-Line of fire set into the wind so that it burns at right angles to the wind

N. Fahrenheit-Measure of temperature with 212° at boiling and 32° at freezing

INFORMATION SHEET

II. Reasons for prescribed burning

   A. Reducing hazardous excessive fuels

   B. Controlling disease

   C. Controlling hardwood

   D. Preparing seedbeds

   E. Preparing planting sites

   F. Improving wildlife habitat

III. Desirable wind conditions (as measured on the burn site)

   A. Direction

      1. Southwest or north

      2. East winds not reliable

   B. Velocity

      1. Minimum 2 mph

      2. Maximum 7 mph

   (NOTE: Wind velocity generally increases from morning to late afternoon.)

IV. Relative humidity (Transparency 1)

   A. Preferred relative humidity range

      1. Minimum 30%

      2. Maximum 50%

INFORMATION SHEET

B. Effects of temperature on relative humidity

1. Increase of temperature decreases relative humidity
2. Decrease of temperature increases relative humidity

Relative Humidity Chart

TEMP	RELATIVE HUMIDITY					
86° F	16%	24%	31%	45%	57%	100%
68° F	28%	42%	54%	79%	100%	
61° F	36%	53%	69%	100%		
50° F	52%	77%	100%			
43° F	67%	100%				
32° F	100%					
	4.85	7.27	9.41	13.65	17.31	30.4

GRAMS OF WATER VAPOR PER CUBIC METER

V. Temperature range for prescribed burning

A. Maximum 50°F.

B. Minimum 20°F.

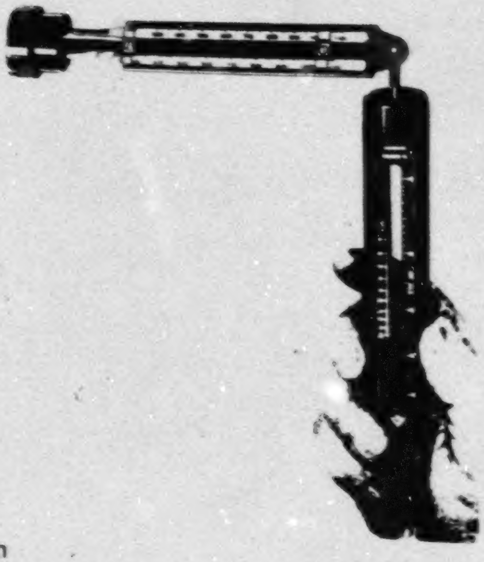
(NOTE: This applies to winter burn and burning in stands, but not to summer burn or timber burn.)

INFORMATION SHEET

VI. Tools for determining wind, relative humidity, and temperature

A. Anemometer

B. Psychrometer



VII. Steps of a burning plan

A. Note weather conditions

1. Days since last rain
2. Wind direction and velocity
3. Temperature range
4. Relative humidity range

INFORMATION SHEET

B. Determine prescribed burning technique

C. Survey manpower needs

1. Firing
2. Holding
3. Patrol and mop-up

D. Survey equipment needs

1. Tools, number and kind
2. Radios
3. Heavy equipment

E. Survey reinforcement crews

1. Number
2. Location

F. Determine fire behavior expected

G. Give overhead instructions

(NOTE: These instructions are for crew leader, fire boss, and construction leaders.)

H. Determine test plot

VIII. Factors which determine the use of the backfire, strip head fire, spot fire, and flank fire techniques (Transparencies 2, 3, 4, and 5)

A. Backfire technique

1. Heavy fuels
2. Small timber (15-24 feet)
3. Minimum scorch
4. Not flexible (after fire lines are plowed)
5. Large area ignited
6. Most expensive technique

INFORMATION SHEET

B. Strip head fire technique

1. Low temperature
2. All fuels
3. Medium to large timber (30 feet +)
4. Large areas
5. High relative himidity
6. Flexible
7. Variable winds

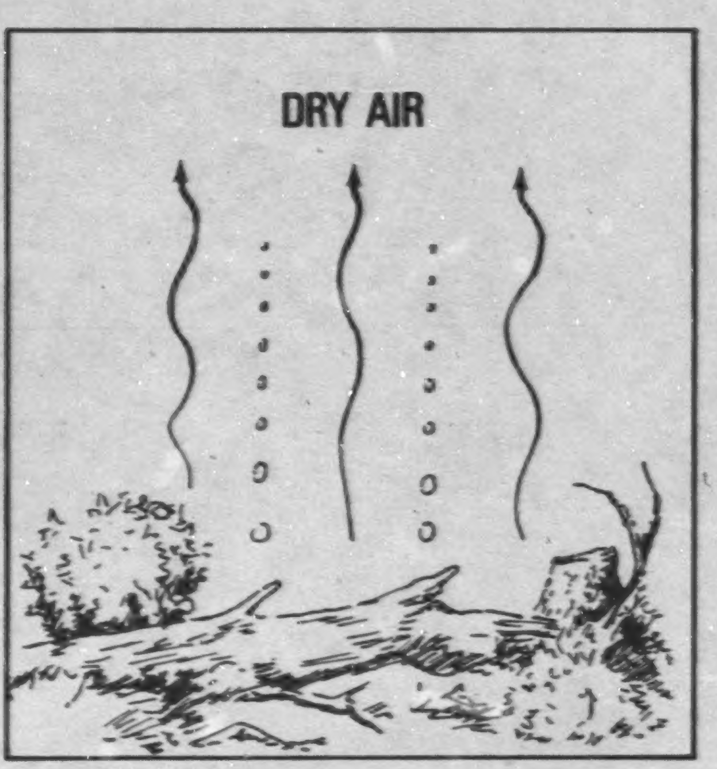
C. Spot fire technique

1. Low temperature
2. Large timber only (45 feet +)
3. Light to medium fuels
4. Variable winds
5. Experienced personnel
6. Cheapest technique

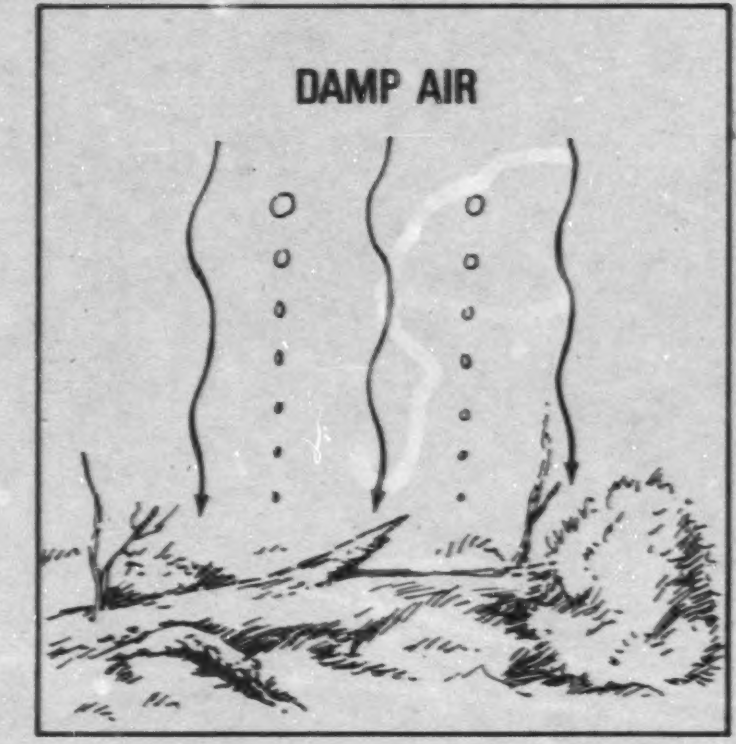
D. Flank fire technique

1. Reliable wind
2. Small areas only
3. Inside area when exterior areas are made safe using backfire or strip head fire techniques
4. Light fuels, not to be used in heavy fuels
5. Medium to large timber
6. Experienced personnel

Relative Humidity Affects Fuels

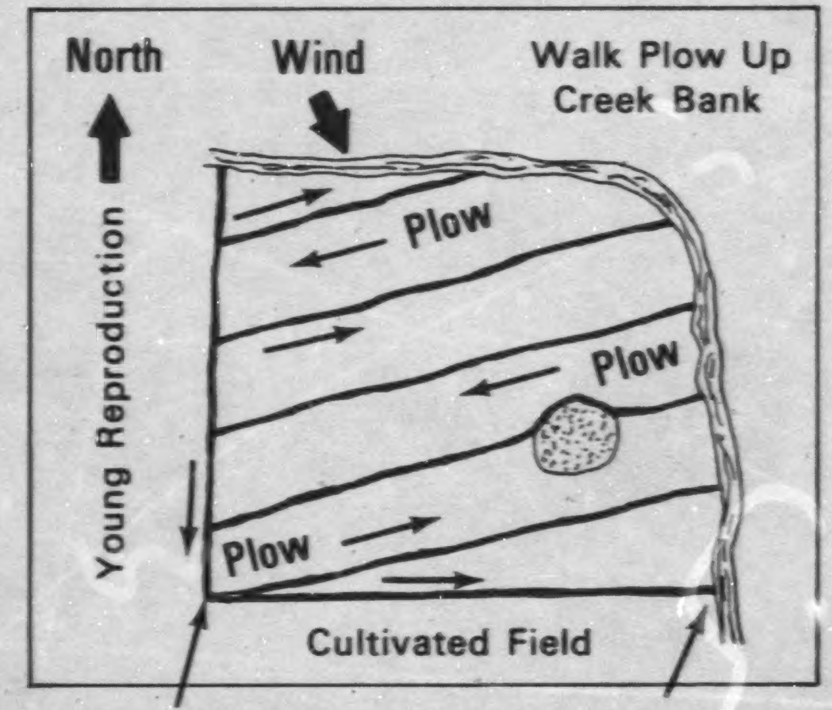


When relative humidity is low, fine fuels lose moisture to the atmosphere.



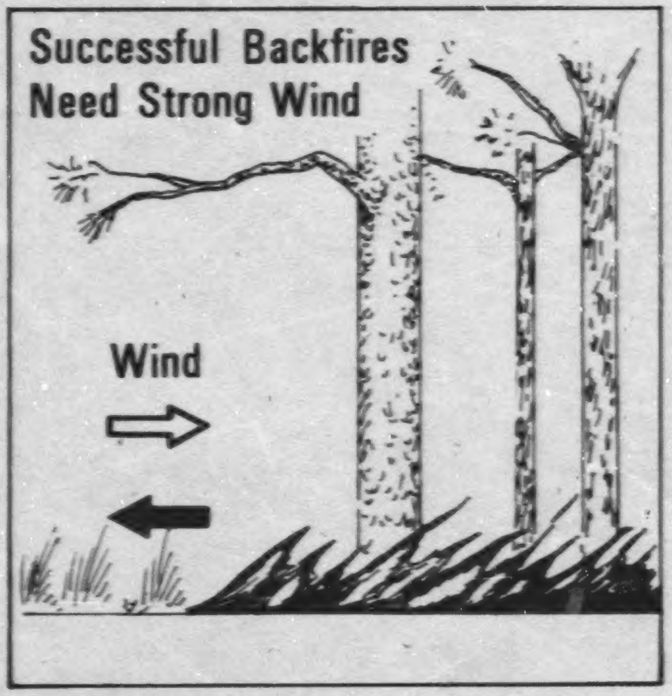
When relative humidity is high, fine fuels gain moisture from the atmosphere.

Backfire Technique


North
Wind
Walk Plow Up
Creek Bank
Young Reproduction
Plow
Plow
Plow
Cultivated Field

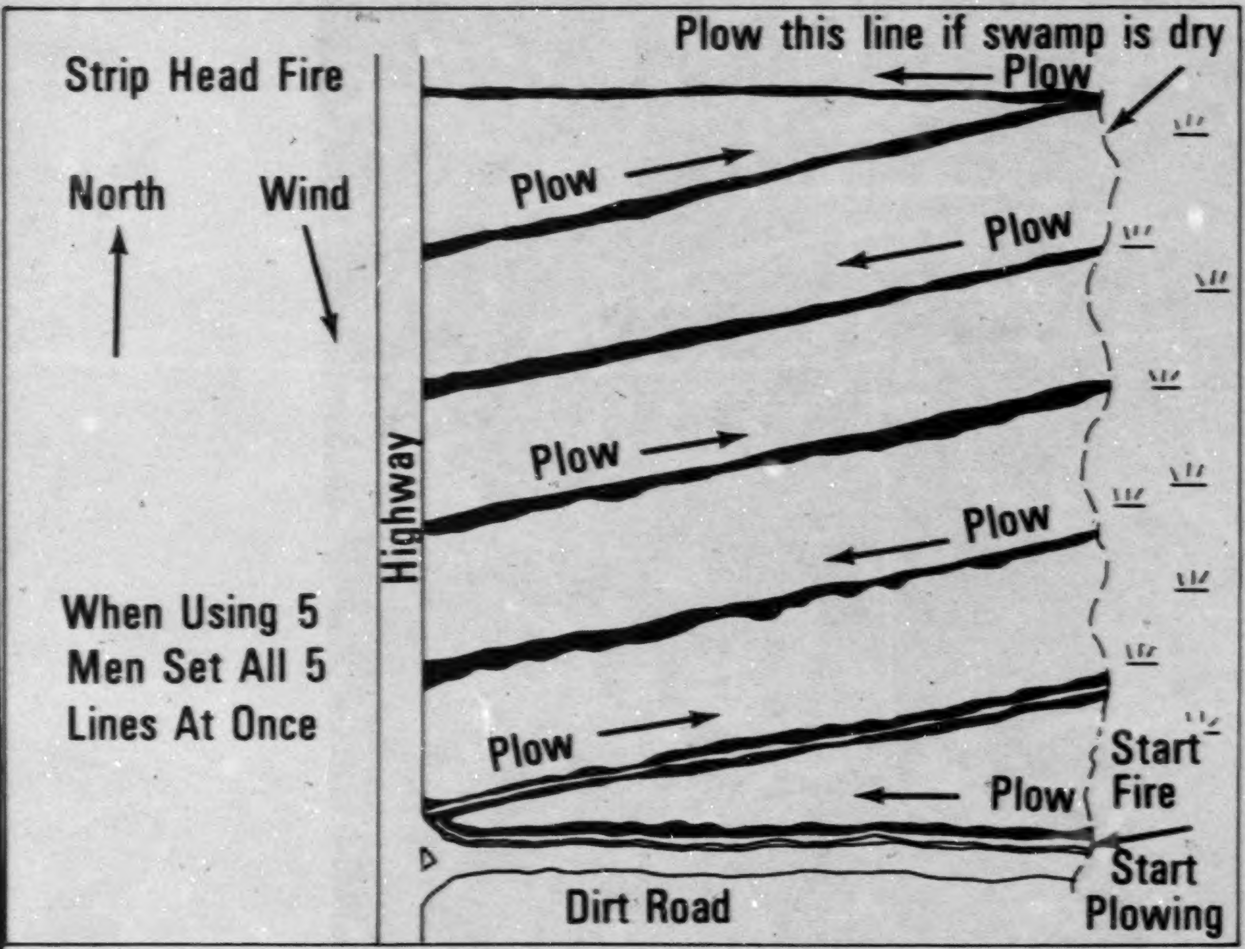
Start and End Plowing

Start Fire


Successful Backfires
Need Strong Wind
Wind

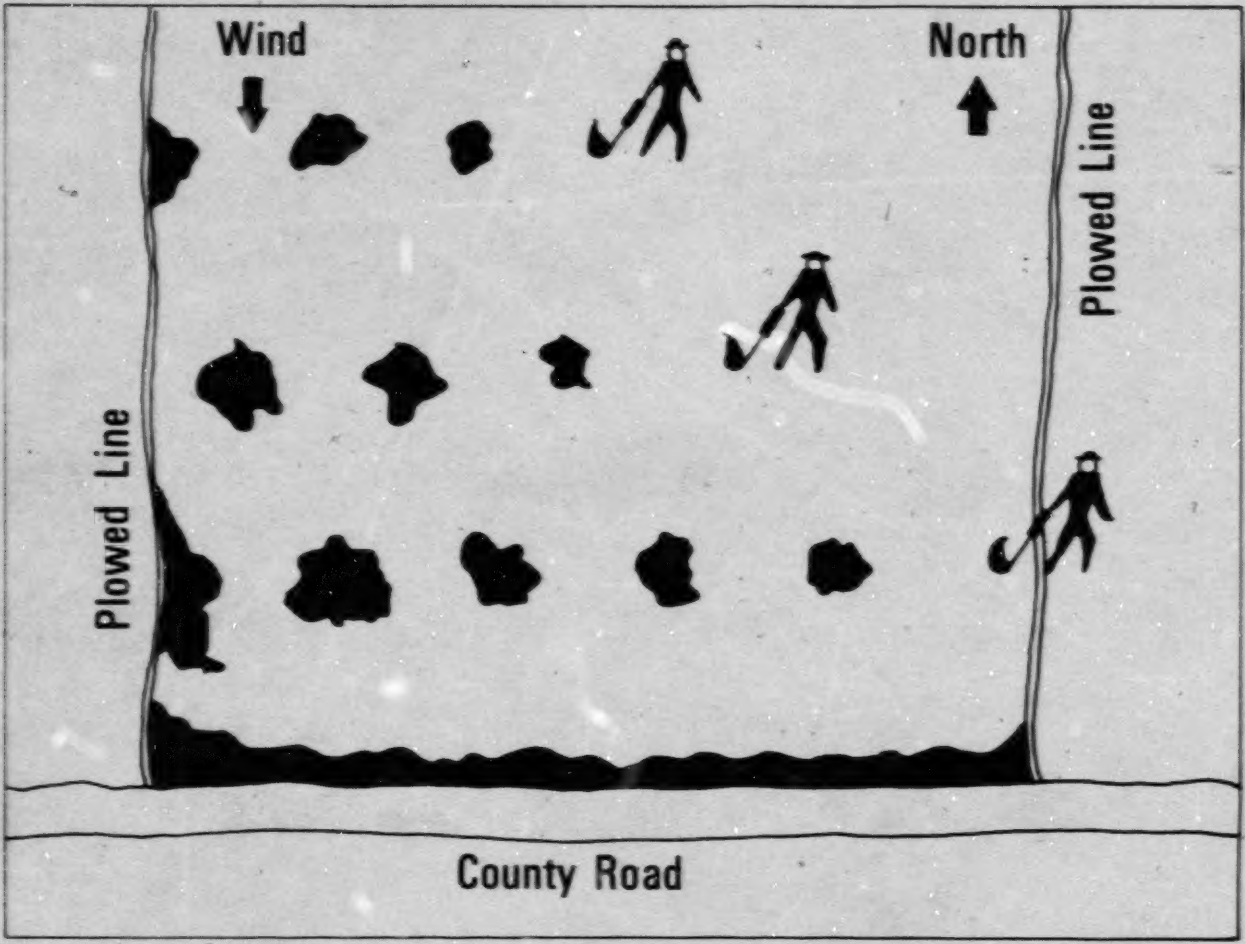
Dispersed Heat Prevents Crown Scorch

Strip Head Fire Technique

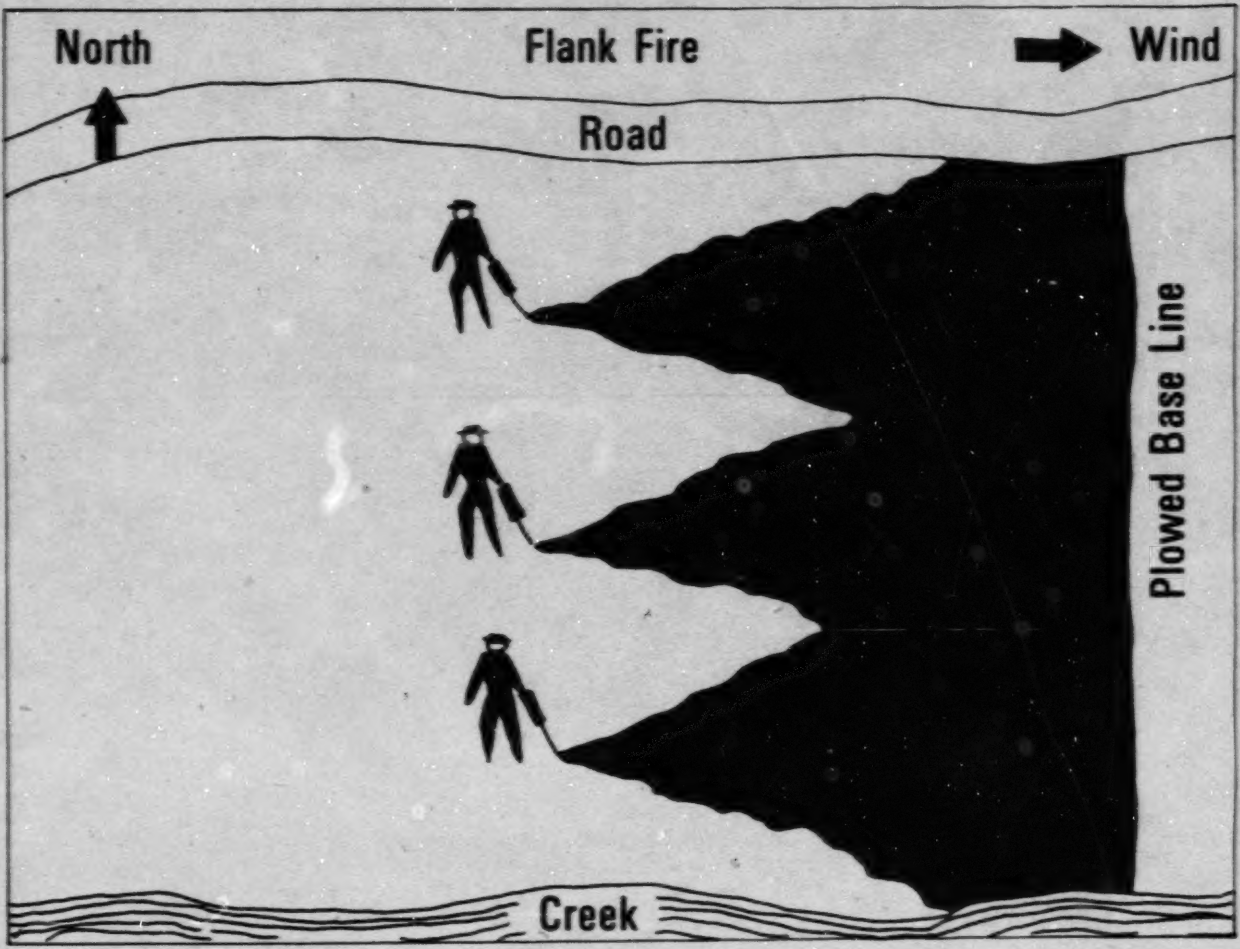

Strip Head Fire
North
Wind
Highway
Plow this line if swamp is dry
Plow
Plow
Plow
Plow
Plow
Plow
Plow
Start Fire
Start Plowing
Dirt Road

When Using 5 Men Set All 5 Lines At Once

Spot Fire Technique


Wind
North
Plowed Line
Plowed Line
County Road

Flank Fire Technique


North
Flank Fire
Wind
Road
Plowed Base Line
Creek

PRESCRIBED BURNING
UNIT II

JOB SHEET #1--DETERMINE WIND DIRECTION AND VELOCITY, RELATIVE HUMIDITY, AND TEMPERATURE

I. Tools and materials needed

   A. Anemometer

   B. Compass

   C. Psychrometer

   D. Bottle or water

   E. Clipboard

   F. Pencil

II. Procedure

   A. Wind direction

      1. Use anything light enough to move with the wind, such as a handkerchief, cloth, or a filled ballon

      2. Locate the direction which gives maximum movement

      3. Use the compass to obtain the cardinal point

   B. Wind velocity

      1. Use the anemometer

         (NOTE: Ask the instructor to demonstrate the correct use of the anemometer if he has not done so.)

      2. Hold the anemometer with the windspeed scale facing you

      3. Read the scale at maximum movement

   C. Relative humidity

      1. Use the psychrometer

         (NOTE: Ask the instructor to demonstrate its correct use if he has not done so.)

JOB SHEET #1

2. Notice the three functional parts of the psychrometer
    a. Dry bulb shows the temperature in Fahrenheit
    b. Wet bulb shows the evaporation rate temperature
    c. Relative humidity scales use the temperature reading of both dry and wet bulbs to give relative humidity
3. Fill the wet bulb moisture chamber with clean water
4. Open the psychrometer to sling position
5. Sling the psychrometer for one full minute
6. Read and record findings below
7. When completed, turn in to the instructor for evaluation

Wind Direction	Wind Velocity	Dry Bulb Temp.	Wet Bulb Temp.	Rel. Humidity

PRESCRIBED BURNING
UNIT II

JOB SHEET #2--DETERMINE PRESCRIBED BURNING TECHNIQUES

I. Tools and materials needed

   A. Clipboard

   B. Pencil

   C. Areas indicated by the instructor

II. Procedure

   A. Review the information sheet

   B. For each of the areas indicated by the instructor, list the burning technique to use

   C. Observe the timber height and fuel types

   D. Place an "X" under the technique which best describes the specific area in question

   E. Turn in to the instructor when completed

Area No.	Backfire	Strip Head Fire	Spot Fire	Flank Fire
1				
2				
3				
4				
5				

PRESCRIBED BURNING
UNIT II

TEST

1. Match the terms on the right to the correct definition.

_____a. Controlled use of fire

_____b. Speed of wind, usually measured in miles per hour

_____c. Actual amount of moisture in air as compared to the amount that air could hold

_____d. Instrument that gives wind speed

_____e. Instrument that gives temperature and relative humidity

_____f. Act of making a fire safe, after it has been controlled or burned, by putting out all embers and sparks at a prescribed distance from the fire line

_____g. Contains a high percent of thick material, such as logs, tree tops, and large limbs

_____h. Contains light material, such as limbs and tree tops less than 4 inches in diameter

_____i. Contains grass and leaves with some small limbs and twigs

_____j. Burning against the wind

_____k. Burning with the wind using short headfires for a safe fire line

_____l. Setting of a series of small fires that burn together before the momentum of an uncontrolled fire is reached

1. Anemometer
2. Light fuel
3. Mop-up
4. Fahrenheit
5. Spot fire
6. Medium fuel
7. Prescribed burning
8. Flank fire
9. Strip head fire
10. Psychrometer
11. Backfire
12. Wind velocity
13. Heavy fuel
14. Relative humidity

_____m. Line of fire set into the wind so that it burns at right angles to the wind

_____n. Measure of temperature with 212° at boiling and 32° at freezing

2. Select from the list below the six correct reasons for prescribed burning by placing an "X" in the space provided.

_____a. Controlling pine

_____b. Improving wildlife habitat

_____c. Controlling disease

_____d. Improving seed germination

_____e. Improving hardwood

_____f. Reducing hazardous excessive fuels

_____g. Controlling hardwood

_____h. Preparing planting sites

_____i. Preparing seedbeds

3. Select from the list below the most desirable wind direction and velocity.

_____a. East wind

_____b. West wind

_____c. North wind

_____d. South wind

_____e. 7 mph

_____f. 10 mph

_____g. 17 mph

_____h. 20 mph

4. List the range of preferred relative humidity and the effects of temperature change on relative humidity.

a. Range

1)

2)

b. Effects

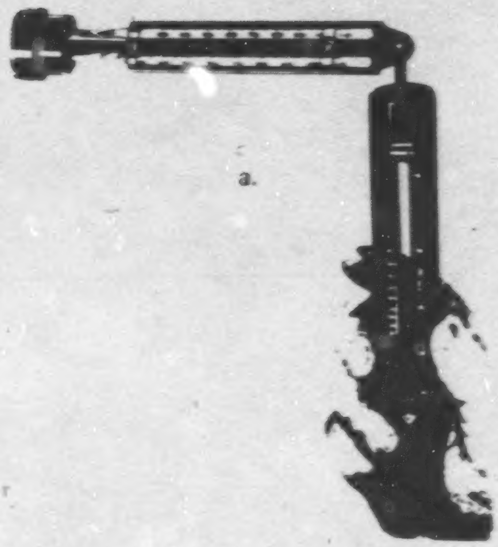
1)

2)

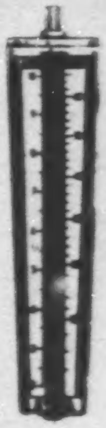
5. Name the desired range of temperature for prescribed burning.

6. Identify these illustrations by name.

a. ______________________ b. ______________________



a.



b.

7. Arrange in numerical order the steps of a burning plan.

_____a. Survey manpower needs

_____b. Determine fire behavior expected

_____c. Note weather conditions

_____d. Determine prescribed burning technique

_____e. Determine test plot

_____f. Give overhead instructions

_____g. Survey equipment needs

_____h. Survey reinforcement crews

8. Distinguish between the prescribed burning techniques. Place a "B" in front of the factors that determine the use of the backfire technique, an "SH" for the strip head technique, an "S" for the spot fire technique, and an "F" for the flank fire technique. There may be more than one technique used for each determining factor given.

_____a. Heavy fuels

_____b. Medium fuels

_____c. Light fuels

_____d. Small timber

_____e. Medium timber

_____f. Large timber

_____g. All fuels

_____h. Not flexible

_____i. Flexible

_____j. Most expensive technique

_____k. Cheapest technique

_____l. Minimum scorch

_____m. Low temperature

_____n. High relative humidity

_____o. Reliable wind

1. B=Backfire

2. SH=Strip head fire

3. S=Spot fire

4. F=Flank fire

______p. Variable winds

______q. Experienced personnel

______r. Small areas

______s. Large areas

9. Demonstrate the ability to:

   a. Determine wind direction and velocity, relative humidity, and temperature.

   b. Determine the prescribed burning technique to use.

   (NOTE: If these have not been accomplished prior to the test, ask the instructor when the above activities should be completed.)

PRESCRIBED BURNING
UNIT II

ANSWERS TO TEST

1.
   - a. 7
   - b. 12
   - c. 14
   - d. 1
   - e. 10
   - f. 3
   - g. 13
   - h. 6
   - i. 2
   - j. 11
   - k. 9
   - l. 5
   - m. 8
   - n. 4
2. b, c, f, g, h, i
3. c, e
4.
   - a. Range
     - 1) Minimum 30%
     - 2) Maximum 50%
   - b. Effects
     - 1) Increase of temperature decreases relative humidity
     - 2) Decrease of temperature increases relative humidity
5. 20° to 50°
6.
   - a. Psychrometer
   - b. Anemometer
7.
   - a. 3
   - b. 6
   - c. 1
   - d. 2
   - e. 8
   - f. 7
   - g. 4
   - h. 5
8.
   - a. B
   - b. S
   - c. S or F
   - d. B
   - e. SH or F
   - f. S, SH, or F
   - g. SH
   - h. B
   - i. SH
   - j. B
   - k. S
   - l. B
   - m. S or SH
   - n. SH
   - o. F
   - p. SH or S
   - q. S or F
   - r. F
   - s. B or SH
9. Performance skills will be evaluated to the satisfaction of the instructor.

INSECT DAMAGE IDENTIFICATION
UNIT III

TERMINAL OBJECTIVE

After completion of this unit, the student should be able to list reasons for identifying insect damage and match direct and indirect control methods to the correct control class. He should also be able to identify classes of insect damage. This knowledge will be evidenced through demonstration and by scoring eighty-five percent on the unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms associated with insect damage identification to the correct definition.
2. List two reasons for identifying insect damage.
3. Match the symptoms to the damage class of insects.
4. Match the direct control methods to the correct control class.
5. Match the indirect control methods to the correct control class.
6. Demonstrate the ability to collect and identify insect damage.

INSECT DAMAGE IDENTIFICATION
UNIT III

SUGGESTED ACTIVITIES

I. Instructor:

   A. Provide students with objective sheet.

   B. Provide students with information and job sheets.

   C. Discuss terminal and specific objectives.

   D. Discuss information sheet.

   E. Demonstrate the ability to accomplish the procedure outlined in the job sheet.

   F. Arrange field trips to allow students an opportunity to practice identifying insect damage.

   G. Give test.

II. Students:

   A. Read objectives.

   B. Study information sheet.

   C. Demonstrate the ability to accomplish the procedure outlined in the job sheet.

   D. Participate in field trip.

   E. Take test.

INSTRUCTIONAL MATERIALS

I. Included in this unit:

   A. Objectives

   B. Information sheet

   C. Job Sheet #1–Collect and Identify Insect Damage

   D. Test

   E. Answers to test

II. Reference–Allen, Shirley Walter and Grant William Sharpe. *An Introduction to American Forestry*. New York: McGraw-Hill Book Co.

INSECT DAMAGE IDENTIFICATION
UNIT III

INFORMATION SHEET

I. Terms and definitions

A. Insect damage--Death, killing of plant organs, or the degrading of quality of wood and wood products

B. Epidemic--Explosion of insect population

(NOTE: The insects that cause damage are generally present, but in small numbers or endemic population.)

C. Sap suckers--Insects that have sucking mouth parts and live on the sap of plants

D. Leaf eaters--Insects that have chewing mouth parts and obtain food by eating leaves

E. Terminal feeders--Insects that attack the growing aerial tips of plants

F. Root feeders--Insects that live underground that suck sap or eat roots of plants

G. Seed and cone borers--Insects that bore into seeds and cones to lay eggs; the seeds are used as food in the larvae stage

H. Larvae--A wormlike immature insect such as a caterpillar

I. Phloem eaters--Insects that eat the phloem tissue of plants

J. Phloem-wood eaters--Insects that eat both the phloem and wood of plants

K. Wood eaters--Insects that attack wood or wood products

L. Necrotic spots--Areas in the plant consisting of dead tissue

M. Galls--An abnormal growth on an organ of the plant which in many cases serves as a habitat for larvae

N. Wilting--The flacid shape of plant tissue that ceases to obtain water

O. Miners--Leaf eaters that eat only the inside tissue of leaves

P. Skeletonizers--Leaf eaters that eat all but the veins of leaves, thus, giving the appearance of a skeleton

Q. Defoliators--Leaf eaters that consume the entire leaf.

INFORMATION SHEET

R. Leaf curlers--Insects that cause the plant to curl upon itself and to serve as a habitat

S. Flagging--The dying of branch tips

T. Pitch tubes--The massing of resin and frass at the entrance of an insect attack on the side of a tree

U. Frass--Insect excrement

V. Galleries--The tunnels formed by insects chewing through the inner bark

W. Sorrels--Dead and dying trees that turn a red color

X. Habitat--An environment suitable for a particular organism

Y. Shot pattern--The exit holes of insects that appear as a shotgun pattern on the side of a tree

Z. Biotic--Of a living condition

AA. Predators--Insects that eat other insects

BB. Parasites--Microscopic organisms that live within or on the body of insects

CC. Quarantine--A law that prohibits movement of any insect habitat such as live plants or certain wood material to another locality until insect preventative or control measures are met

DD. Embargo--A law that prohibits movement of an insect habitat to another locality

EE. Inspection--An orderly search of an insect habitat for eggs, larvae, or the adult insect

FF. Certification--A document which indicates that an inspection was performed and no evidence of insect infestation was found

II. Reasons for identifying insect damage

A. Rapid epidemic potential--Prevents epidemics

B. Most volume loss through death of timber--Prevents volume loss

III. Symptoms of damage class insects

A. Sap suckers

1. Necrotic spots or galls on leaves and twigs

2. Wilting

INFORMATION SHEET

B. Leaf eaters
   1. Mining
   2. Skeletonizing
   3. Defoliating
   4. Leaf curling

C. Terminal feeders
   1. Flagging
   2. Resinous flow on conifers

D. Root feeders
   1. Wilting, eventual death
   2. Death on one side of the plant with no apparent reason

E. Seed and cone borers
   1. Hollow seeds and cones
   2. Resinous flow from cones

F. Phloem eaters
   1. Pitch tubes
   2. Galleries inside bark
   3. Sorrels
   4. Emergent holes

G. Phloem-wood eaters
   1. Sawdust from entry holes
   2. Wood with sap flow

H. Wood eaters
   1. Sawdust
   2. Shot pattern

INFORMATION SHEET

IV. Direct control methods by classes

- A. Mechanical
  - 1. Collecting
  - 2. Trapping
  - 3. Destroying in habitat
  - 4. Debarking to kill eggs and larvae
- B. Biotic
  - 1. Predators
  - 2. Parasites
- C. Chemical
  - 1. Dusting
  - 2. Spraying
  - 3. Fumigating
  - 4. Poisonous bait

V. Indirect control methods

- A. Mechanical
  - 1. Modify food supply
  - 2. Modify moisture conditions
  - 3. Modify temperature
- B. Biotic
  - 1. Increase competition
  - 2. Encourage parasites and predators
- C. Sivicultural
  - 1. Regulate composition or species improvement
  - 2. Regulate species vigor

INFORMATION SHEET

D. Statutory regulations

1. Quarantines
2. Embargoes
3. Inspection
4. Certification

INSECT DAMAGE IDENTIFICATION
UNIT III

JOB SHEET #1-COLLECT AND IDENTIFY INSECT DAMAGE

I. Materials needed:

- A. Pencil and paper
- B. Chart
- C. Insect damage chart, pictures, or key

II. Procedure

- A. Fill in the necessary information on the following chart
- B. Label the specimen with the same number used on the chart
- C. Sign your name to each specimen
- D. When completed, turn in to the instructor for evaluation

Speci-men No.	Tree Species	Date Found	Tree Organ Effected	Place an "x" in the correct space for insect damage class							
				Sap Sucker	Leaf Eater	Terminal Eater	Seed & Cone	Root Eater	Phloem	Phloem-Wood	Wood
1											
2											
3											
4											
5											
6											
7											
8											

JOB SHEET #1

INSECT DAMAGE IDENTIFICATION
UNIT III

TEST

1. Match the terms on the right to the correct definition.

_____a. Death, killing of plant organs, or the degrading of quality of wood and wood products

_____b. Explosion of insect population

_____c. Insects that have sucking mouth parts and live on the sap of plants

_____d. Insects that have chewing mouth parts and obtain food by eating leaves

_____e. Insects that attack the growing aerial tips of plants

_____f. Insects that live underground that suck sap or eat roots of plants

_____g. Insects that bore into seeds and cones to lay eggs; the seeds are used as food in the larvae stage

_____h. A wormlike immature insect such as a caterpillar

_____i. Insects that eat the phloem tissue of plants

_____j. Insects that eat both the phloem and wood of plants

_____k. Insects that attack wood or wood products

1. Larvae
2. Miners
3. Wood eaters
4. Sorrels
5. Flagging
6. Certification
7. Biotic
8. Embargo
9. Root feeders
10. Pitch tubes
11. Leaf eaters
12. Phloem-wood eaters
13. Shot pattern
14. Leaf curlers
15. Insect damage
16. Skeletonizers
17. Inspection
18. Phloem eaters
19. Quarantine
20. Predators
21. Epidemic

_____l. Areas in the plant consisting of dead tissue

_____m. An abnormal growth on an organ of the plant which in many cases serves as a habitat for larvae

_____n. The flacid shape of plant tissue that ceases to obtain water

_____o. Leaf eaters that eat only the inside tissue of leaves

_____p. Leaf eaters that eat all but the veins of leaves, thus, giving the appearance of a skeleton

_____q. Leaf eaters that consume the entire leaf

_____r. Insects that cause the plant to curl upon itself and to serve as a habitat

_____s. The dying of branch tips

_____t. The massing of resin and frass at the entrance of an insect attack on the side of a tree

_____u. Insect excrement

_____v. The tunnels formed by insects chewing through the inner bark

_____w. An environment suitable for a particular organism

_____x. Dead and dying trees that turn a red color

_____y. The exit holes of insects that appear as a shotgun pattern on the side of a tree

_____z. Of a living condition

22. Defoliators
23. Seed and cone borers
24. Galls
25. Parasites
26. Galleries
27. Habitat
28. Sap suckers
29. Wilting
30. Frass
31. Terminal feeders
32. Necrotic spots

____aa. Insects that eat other insects

____bb. Microscopic organisms that live within or on the body of insects

____cc. A law that prohibits movement of any insect habitat such as live plants or certain wood material to another locality until insect preventative or control measures are met

____dd. A law that prohibits movement of an insect habitat to another locality

____ee. An orderly search of an insect habitat for eggs, larvae, or the adult insect

____ff. A document which indicates that an inspection was performed and no evidence of insect infestation was found

2. List two reasons for identifying insect damage.

a.

b.

3. Match the symptoms on the right to the specific damage class of insects by placing the correct numbers in the blanks provided. (Answers may be used more than once.)

_____a. Sap suckers

_____b. Leaf eaters

_____c. Terminal feeders

_____d. Root feeders

_____e. Seed and cone borers

_____f. Phloem eaters

_____g. Phloem-wood eaters

1. Mining
2. Leaf curling
3. Necrotic spots or galls on leaves and twigs
4. Sorrels
5. Sawdust
6. Flagging
7. Pitch tubes

(Continued on next page)

_____h. Wood eaters	8.	Skeletonizing
	9.	Wilting
	10.	Galleries inside bark
	11.	Defoliating
	12.	Wood with sap flow
	13.	Resinous flow from cones
	14.	Sawdust from entry holes
	15.	Resinous flow on conifers
	16.	Hollow seeds and cones
	17.	Death on one side of plant
	18.	Emergent holes
	19.	Shot pattern

4. Match the direct control methods on the right to the correct control class by placing the correct numbers in the blanks provided.

DIRECT CONTROL CLASSES		DIRECT CONTROL METHODS
_____a. Mechanical	1.	Dusting
_____b. Biotic	2.	Predators
_____c. Chemical	3.	Spraying
	4.	Destroying in habitat
	5.	Parasites
	6.	Collecting
	7.	Fumigating
	8.	Trapping
	9.	Poisonous bait
	10.	Debarking to kill eggs and larvae

5. Match the indirect control methods on the right to the correct control class by placing the correct numbers in the blanks provided.

INDIRECT CONTROL CLASSES

_____a. Mechanical

_____b. Biotic

_____c. Sivicultural

_____d. Statutory regulations

INDIRECT CONTROL METHODS

1. Increase competition
2. Quarantines
3. Regulate composition or species improvement
4. Embargoes
5. Inspection
6. Regulate species vigor
7. Modify food supply
8. Certification
9. Modify moisture conditions
10. Encourage parasites and predators
11. Modify temperature

6. Demonstrate the ability to collect and identify insect damage.

(NOTE: If this has not been accomplished prior to the test, ask the instructor when the above activity should be completed.)

INSECT DAMAGE IDENTIFICATION
UNIT III

ANSWERS TO TEST

1. a. 15
   b. 21
   c. 28
   d. 11
   e. 31
   f. 9
   g. 23
   h. 1
   i. 18
   j. 12
   k. 3
   l. 32
   m. 24
   n. 29
   o. 2
   p. 16
   q. 22
   r. 14
   s. 5
   t. 10
   u. 30
   v. 26
   w. 27
   x. 4
   y. 13
   z. 7
   aa. 20
   bb. 25
   cc. 19
   dd. 8
   ee. 17
   ff. 6

2. a. Rapid epidemic potential--Prevents epidemics
   b. Most volume loss through death of timber--Prevents volume loss

3. a. 3, 9
   b. 1, 2, 8, 11
   c. 6, 15
   d. 9, 17
   e. 13, 16
   f. 4, 7, 10, 18
   g. 12, 14
   h. 5, 19

4. a. 4, 6, 8, 10
   b. 2, 5
   c. 1, 3, 7, 9

5. a. 7, 9, 11

   b. 1, 10

   c. 3, 6

   d. 2, 4, 5, 8

6. Performance skills will be evaluated to the satisfaction of the instructor.

FOREST BUSINESS METHODS
UNIT I

TERMINAL OBJECTIVE

After completion of this unit, the student should be able to inspect a current timber sale for contract compliance and list the six basic items of selling timber. He should also be able to select from a list essential elements of an offer, items which may result in th termination of an offer, and the essential parts of a contract. This knowledge will be evidenced through demonstration and by scoring eighty-five percent on the unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms associated with forest business methods to the correct definition.
2. List eight categories of records necessary in a forest business operation.
3. List six basic items of selling timber.
4. Arrange in numerical order the steps of the bidding procedure.
5. Select from a list four essential elements of an offer.
6. Select from a list the seven items which may result in the termination of an offer.
7. Select from a list four essential parts of a contract.
8. Identify the parts of a contract.
9. Demonstrate the ability to inspect a timber sale for contract compliance.

FOREST BUSINESS METHODS
UNIT I

SUGGESTED ACTIVITIES

I. Instructor:

   A. Provide students with objective sheet.

   B. Provide students with information, assignment, and job sheets.

   C. Make transparencies.

   D. Discuss terminal and specific objectives.

   E. Discuss information and assignment sheets.

   F. Demonstrate and discuss procedure outlined in the job sheet.

   G. Arrange field trips to allow students an opportunity to practice contract compliance.

   H. Give test.

II. Students:

   A. Read objectives.

   B. Study information sheet.

   C. Complete assignment sheet.

   D. Demonstrate the ability to accomplish the procedure outlined in the job sheet.

   E. Participate in field trip.

   F. Take test.

INSTRUCTIONAL MATERIALS

I. Included in this unit:

   A. Objectives

   B. Information sheet

   C. Assignment Sheet #1–Identify the Parts of a Contract

D. Job Sheet #1--Inspect a Timber Sale for Contract Compliance

E. Test

F. Answers to test

II. Reference: Allen, Shirley Walter and Grant William Sharpe. *An Introduction to American Forestry*. New York: McGraw-Hill Book Co., Inc.

FOREST BUSINESS METHODS
UNIT I

INFORMATION SHEET

I. Terms and definitions

   A. Need–In timber sales, the sivicultural need of the timber stand

   B. Bidding procedure--The act of soliciting buyers to bid on a timber sale

   C. Contract--An enforceable agreement between two or more parties

   D. Contract compliance--The inspection of a going timber sale to check for adherence to the terms of the contract

   E. Offer--A proposal by one person to enter into a legal relation with another

   F. Offeror--The one who proposed the offer

   G. Ofference--The one who accepts the proposal

   H. Revocation--A withdrawal of an offer before it has been accepted

   I. Rejection--To turn down an offer

   J. Counteroffer--To make another offer instead of accepting the original offer

   K. Consideration--A kind of bargained for price not necessarily money

   L. Competent parties--Persons having the legal right to form a contract

   M. Legal objective--To contract for legal merchandise

   N. Prospectus--Particulars of a sale of timber such as location, products, method of bidding, when to sell, and how timber is sold

II. Forest business records

   A. Bookkeeping

   B. Labor

   C. Equipment

   D. Inventory

INFORMATION SHEET

- E. Timber tract
- F. Cutting
- G. Forest improvement
- H. Maps

III. Basic items of selling timber

- A. Need
- B. Products available
- C. Designation and measurement of products
- D. Bidding procedure
- E. Contract
- F. Contract compliance

IV. Bidding procedure

- A. Prospectus
- B. Advertisement
- C. Offer
- D. Acceptance of offer

V. Essential elements of the offer

- A. Offered with the intention of forming a contract
- B. Considered more than a negotiating instrument
- C. Definite and complete in content
- D. Communicated from offeror to offeree

VI. Items which may result in the termination of an offer

- A. Revocation
- B. Unacceptable terms in the offer
- C. Lapse of reasonable time

INFORMATION SHEET

- D. Rejection
- E. Counteroffer
- F. Destruction of subject matter
- G. Subsequent illegality

VII. Essential parts of a contract

- A. Offer and acceptance
- B. Consideration
- C. Competent parties
- D. Legal objective

FOREST BUSINESS METHODS
UNIT I

ASSIGNMENT SHEET #1–IDENTIFY THE PARTS OF A CONTRACT

On the contract given on the following page locate, circle in pencil, and identify by number these parts:

1. Offer and acceptance
2. Consideration
3. Competent parties
4. Legal objective

When completed, turn in to the instructor for evaluation.

10-F

FOREST LANDOWNER-LOGGING OPERATOR CONTRACT

This CONTRACT made and entered into this __________ day of __________, 19____, by and between ____ of __________ (state), owner of timber to be cut hereinafter referred to as the Owner, and ______________________________ of ____________________, hereinafter referred to as the Operator.

WITNESSETH:

Whereas, the Owner owns standing timber located in __________ and whereas, the Operator desires to contract with the Owner to ______________________________ and ______________________________ for the requirements of the Owner, now, therefore, it is agreed between the parties.

I. The Operator agrees that he will ____________________ and __________ __________ all the marked or designated timber, standing and being on the __________ __________ owned by the Owner and situated in ____________________ __________.

II. The owner agress to pay for the ____________________ and __________ __________ of said timber the sum of __________ per __________ as measured by the __________ rule by ____________________ at the ____________________ __________. Payment for these services shall be made to the Operator on __________ ____________________.

III. The Operator agrees to use proper precautions to avoid damage to fences and other property of the Owner; and agrees to indemnify the Owner against any and all damage and injury to any person or persons, including employees of the Operator caused or arising out of said operation.

IV. The Operator further agrees that the work will be done in a workmanlike manner and completed on or before ____________________.

V. The Operator agrees to comply with all federal and state laws or regulations controlling his operations, including state forest practices laws governing leaving of seed trees. The Operator agrees to indemnify and hold harmless the Owner from any and all claims or demands which may be made against him by reason of the Operator's operation or violation by the Operator of any laws or regulations governing said operation.

VI. It is mutually understood by the parties hereto that the Operator is not an employee of the Owner, but that he is an independent contractor; also, that if the Operator subcontracts any portion of the operation, the Operator as primary contractor shall be responsible for all acts by subcontractor.

VII. It is agreed between the Owner and Operator that the payment of __________ __________ per ____________________ of timber cut as hereinbefore specified shall include full payment for the use of any and all equipment used in connection with the operation.

VIII. It is agreed that the Owner may terminate the cutting at any time by providing the Operator with written notice of date of termination at least ___________ in advance of date of termination and by paying in full as above specified for all material ___________ ___________ and ________________________ by the Operator.

In Witness Whereof, the parties have hereunto set their hands the day and the year first above written.

WITNESSES:	SIGNED:
________________________________	______________________, Operator
________________________________	
(For the Operator)	
________________________________	______________________, Owner
________________________________	
(For the Owner)	

FOREST BUSINESS METHODS
UNIT I

JOB SHEET #1-INSPECT A TIMBER SALE FOR CONTRACT COMPLIANCE

I. Tools and materials needed

- A. Compass
- B. Copy of the sale contract
- C. Sale contract compliance summary form

II. Procedure

- A. Instructor will assign a plot of timber for sale
- B. Fill in the blanks provided on the attached sale contract compliance summary form on the following pages
- C. When completed, turn in to the instructor for evaluation

JOB SHEET #1

SALE CONTRACT COMPLIANCE INSPECTION SUMMARY

1. SALE DESIGNATION ____
(FOREST, COMPARTMENT, PURCHASER, DATE)
2. DATE OF INSPECTION ________ PAYMENT UNIT ________ PERCENT OF UNIT COMPLETED ________
3. SUMMARY OF THE SALE AREA CONDITIONS AS REPORTED OR NOTED PRIOR TO INSPECTION FROM PREVIOUS INSPECTIONS OR "SPOT CHECKS" ______________________________
4. PREVIOUS ACTION TAKEN TO SECURE CONTRACT COMPLIANCE: ORAL ________ WRITTEN ________
BY ____________________ TO ____________________ ____________
(FOREST OFFICER) (COMPANY REPRESENTATIVE) (DATE)
NATURE OF REQUESTED COMPLIANCE: ______________________________
5. COMPLAINTS REGISTERED BY PURCHASER ____________ ______________________
(DATE) (NATURE OF COMPLAINT)
(CITE ACTION TAKEN TO SETTLE - WHEN TAKEN, WHO WITH, WRITTEN OR VERBAL, ETC. AND RESULTS)
6. CONDITION FOUND (BASED ON SYSTEMATIC INSPECTION, STRIP LOCATED ON SALE AREA MAP):
A. CUTTING OPERATION: LENGTH OF 1 CHAIN STRIP ___ CHAINS = ___ ACRES INSPECTED: ____

UNCUT MARKED TREES				CUT TREES/LOGS LEFT				TREES DAMAGED				
SPECIES	DBH	NO. LOGS	VOL. MBF/ CUFT	SPECIES	DBH/ DIB	LGTH	VOL. MBF/ CUFT	SPECIES	DBH	VOL.	HT	KIND

NUMBER OF 1/5 ACRE PLOTS CHECKED ____________ = ACRES INSPECTED ____________

STUMP HEIGHT				WASTE-LONG BUTT & TOP, BREAKAGE					UNMARKED TREES CUT			
NO. OK		NO. TOO HIGH		SPECIES	DIB	LGTH	VOLUME MBF/ OR CUFT	BUTT (B) TOP (T) BREAK (BR)	SPECIES	STUMP DIB	NO. LOGS	VOLUME MBF/ OR CUFT
S.T	P.W.	S.T.	P.W.									

B. LOG MAKING: (NORMAL) (LONG LOG) OR (TREE LENGTH)
1. AVERAGE TRIM ALLOWANCE AS CUT ____ INCHES
2. NUMBER OF LOGS MEASURES ___ NUMBER EXCEEDING TRIM ALLOWANCE ______

C. CONDITION OF MARKING PAINT

JOB SHEET #1

7. ROADS

A. ARE TEMPORARY LOGGING ROADS, SKID TRAILS, AND LOG LANDINGS CONSTRUCTED, MAINTAINED AND LAID-BY IN ACCORDANCE WITH CONTRACT SPECIFICATIONS? (IF "NO", EXPLAIN) ____________________

B. STATE PROGRESS AND COMPLIANCE WITH CONTRACT SPECIFICATIONS, OF SPECIFIED ROAD CONSTRUCTION ____________________

C. IS PURCHASER DOING HIS OWN REQUIRED SHARE OF SYSTEM ROAD MAINTENANCE, IS HE PERFORMING IN ACCORDANCE WITH A WRITTEN AGREEMENT DEFINING "HIS SHARE"? (IF "NO", EXPLAIN) ____________________

8. EROSION CONTROL

A. SEEDING DONE AS REQUIRED? (IF "NO", EXPLAIN) ____________________

B. ARE MILL SETS, CAMPS, ETC., PROPERLY LAID-BY AFTER ABANDONMENTS? (IF "NO" EXPLAIN) ____________________

9. SLASH DISPOSAL - ARE SLASH DISPOSAL REQUIREMENTS BEING MET CURRENTLY? (IF "NO", EXPLAIN) ____________________

10. FIRE CONTROL:

A. HAVE MILL SITES AND CAMPS BEEN FIRE-PROOFED; ARE SAFE ARRANGEMENTS FOR SLAB AND SAWDUST BURNING IN EFFECT? (IF "NO", EXPLAIN) ____________________

B. HAS PURCHASER MET OTHER CONTRACTUAL FIRE PREVENTION AND CONTROL REQUIREMENTS? ____________________

11. CONSUMER RETURN SCALE:
ANY OBSERVATION ON SALE AREA LEADING TO QUESTION ON RELIABILITY OF CONSUMER RETURNS: ____________________

12. OTHER: ADEQUACY OF PURCHASER SUPERVISION, SANITATION, SAFETY PRACTICES, PAYMENTS, ETC. ____________________

13. SUMMARY OF ACTION REQUIRED OF PURCHASER TO MEET REQUIREMENTS FOR ACCEPTANCE ____________________

14. FOLLOW-UP ACTION: ORAL WITH ____________ (Name of Company Representative) ____________ (By) ____________ (Date)

____________________ (RESULTS)

WRITTEN TO ____________ (PURCHASER) ____________ (BY) ____________ (DATE) ____________ (RESULTS)

15. SUBMITTED: ________ (DATE) BY ____________ (FOREST OFFICER) REVIEWED & APPROVED ________ (DATE) BY ____________ (DISTRICT RANGER)

16. FINAL SPOT CHECK ____________ (DATE) BY ____________ (FOREST OFFICER)

17. PAYMENT UNIT ACCEPTED ________ (DATE) ____________ (DISTRICT RANGER) NOTIFICATION OF PURCHASER IN WRITING ____________

FOREST BUSINESS METHODS
UNIT I

TEST

1. Match the terms on the right to the correct definition.

_____a. In timber sales, the sivicultural need of the timber stand

_____b. The act of soliciting buyers to bid on a timber sale

_____c. An enforceable agreement between two or more parties

_____d. The inspection of a going timber sale to check for adherence to the terms of the contract

_____e. A proposal by one person to enter into a legal relation with another

_____f. The one who proposed the offer

_____g. The one who accepts the proposal

_____h. A withdrawal of an offer before it has been accepted

_____i. To turn down an offer

_____j. To make another offer instead of accepting the original offer

_____k. A kind of bargained for price not necessarily money

_____l. Persons having the legal right to form a contract

_____m. To contract for legal merchandise

_____n. Particulars of a sale of timber such as location, products, method of bidding, when to sell, and how timber is sold

1. Offer
2. Counteroffer
3. Competent parties
4. Contract compliance
5. Revocation
6. Need
7. Consideration
8. Offeror
9. Bidding procedure
10. Legal objective
11. Rejection
12. Contract
13. Ofference
14. Prospectus

2. List eight categories of records necessary in a forest business operation.

a. | e.
b. | f.
c. | g.
d. | h.

3. List six basic items of selling timber.

a. | d.
b. | e.
c. | f.

4. Arrange in numerical order the steps of the bidding procedure.

_____a. Offer

_____b. Advertisement

_____c. Acceptance of offer

_____d. Prospectus

5. Select from the list below the four essential elements of an offer by placing an "X" in the blanks provided.

_____a. Definite and complete in content

_____b. Advertised for thirty days

_____c. Considered more than a negotiating instrument

_____d. Communicated from offeror to offeree

_____e. Offered with the intention of forming a contract

_____f. Written by a lawyer

6. Select from the list below the seven ways to terminate an offer by placing an "X" in the blanks provided.

_____a. Change of mind

_____b. Destruction of subject matter

_____c. Revocation

_____d. Lapse of reasonable time

_____e. Acceptance

_____f. Unacceptable terms in the offer

_____g. Subsequent illegality

_____h. Lack of advertisement

_____i. Rejection

_____j. Counteroffer

7. Select from the list below the four essential parts to a contract by placing an "X" in the blanks provided.

_____a. Legal objective

_____b. Heading

_____c. Competent parties

_____d. Subject matter

_____e. Consideration

_____f. Offer and acceptance

8. Identify the parts of a contract.

9. Demonstrate the ability to determine a timber sale contract compliance.

(NOTE: If test questions 8 and 9 have not been accomplished prior to the test, ask the instructor when the above activities should be completed.)

FOREST BUSINESS METHODS
UNIT I

ANSWERS TO TEST

1.
   - a. 6
   - b. 9
   - c. 12
   - d. 4
   - e. 1
   - f. 8
   - g. 13
   - h. 5
   - i. 11
   - j. 2
   - k. 7
   - l. 3
   - m. 10
   - n. 14
2.
   - a. Bookkeeping
   - b. Labor
   - c. Equipment
   - d. Inventory
   - e. Timber tract
   - f. Cutting
   - g. Forest improvement
   - h. Maps
3.
   - a. Need
   - b. Products available
   - c. Designation and measurement of products
   - d. Bidding procedure
   - e. Contract
   - f. Contract compliance
4.
   - a. 3
   - b. 2
   - c. 4
   - d. 1
5. a, c, d, e
6. b, c, d, f, g, i, j
7. a, c, e, f
8. Evaluated to the satisfaction of the instructor.
9. Performance skill will be evaluated to the satisfaction of the instructor.

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